



CATV CABLE CONSTRUCTION MINI - MANUAL

 **Comm/Scope**
A *MA*COM COMPANY

Route 1, Box 199A
Catawba, North Carolina 28609



3RD EDITION

CATV

**CABLE
CONSTRUCTION**

MINI - MANUAL



Route 1, Box 199A
Catawba, North Carolina 28609

Published Dec. 1980

CATV CABLE CONSTRUCTION MINI-MANUAL

The information and procedures presented in this manual are intended to be a helpful guide for the handling and installation of coaxial cable for CATV Systems. It is not intended to be applicable or suited to every circumstance which might arise during construction phases of CATV Systems. No warranty is implied nor expressed and this manual should not be construed to be a replacement for sound judgment and experience as applied to actual field circumstances.



Rt. 1, Box 199A
Catawba, N. C. 28609
(704) 241-3142

Frank M. Drendel
President

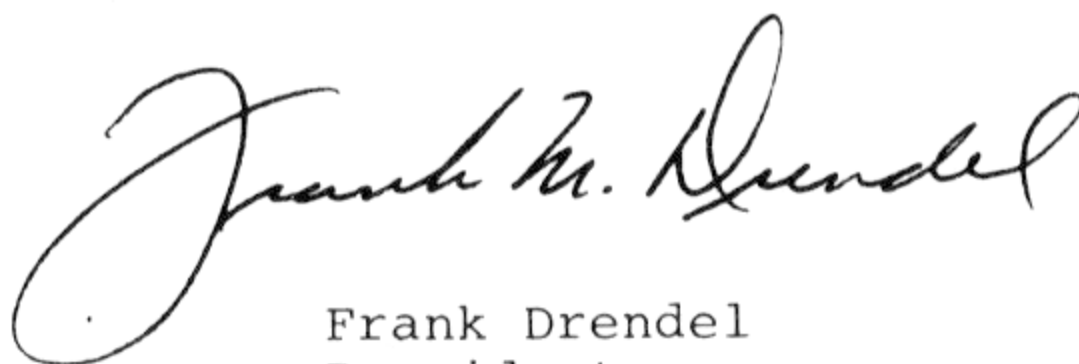
All of us here at Comm/Scope hope that the information provided in the following pages will in some way make your job a little easier.

You see, as the world's leading manufacturer of coaxial cable, our goal is more than just providing you with the finest coaxial cable available.

Proper construction techniques combined with Comm/Scope cable products is enabling our industry to build state of the art CATV systems that are fast becoming a major influence in both home and business communications in the 1980's.

Together we are building a better America.

Respectfully,



Frank Drendel
President

CATV CABLE CONSTRUCTION MANUAL
CONTENTS

	Page
IM - Cable installation procedures - IM cable	IM-49
Installation procedures - drive off routes - Integral messenger (IM)	IM-50
Installation procedures - back pull - routes Integral messenger (IM)	IM-52
Installation procedures - back pull - winch Integral messenger (IM)	IM-53
Installation procedures - expansion loop	IM-53
Installation procedures - multiple cables	IM-54
List of illustrations	IM-55
Illustrations	IM-56
IL - Cable installation procedures - lashed cable	IL-67
Installation procedures - drive off routes	IL-68
Installation procedures - back pull routes	IL-69
Installation procedures - winch	IL-70
Installation procedures - expansion loop	IL-71
List of illustrations	IL-72
Illustrations	IL-73

	Page
UG - Cable installation procedures - underground	UG-83
General	UG-84
Installation procedures - easement routes	UG-84
Installation procedures - plowing	UG-87
Installation procedures - boring	UG-87
Installation procedures - street cuts	UG-89
Installation procedures - street routes	UG-89
Installation procedures - open area routes	UG-90
Installation procedures - cable pulling	UG-91
List of illustrations	UG-92
Illustrations	UG-93
 SR - Special installation procedures and reference data	 SR-99
Cable placing - lashing wire clamp and aerial support	 SR-100
Cable placing - aerial cable support and spacer	 SR-101
Underground dips	SR-102
Extension arms	SR-103
Expansion loop bending tool	SR-104
Fabricated loop forming tool	SR-104

Cable Installation Procedures (IM) Cable

CABLE HANDLING AND INSTALLATION PROCEDURES - INTEGRAL MESSENGER (IM)

The installation of integral messenger type coaxial cables is undertaken with caution and attention to maximum sag and tension recommendations. Tensional forces are introduced to IM coaxial cable in a manner quite different from lashed type constructions. The effects of construction introduced tensional forces and subsequent low temperature service conditions can be substantially reduced through the use of positive conductor anchoring (captive contact connectors) and proper expansion loops.

There are two different sets of circumstances which prevail when stringing IM cable. There are those routes considered as drive off and those routes considered as back pull.

INSTALLATION PROCEDURES - DRIVE OFF ROUTES - INTEGRAL MESSENGER (IM)

When the tools have been selected, after reviewing the Tool Section, and the cable reels to be placed are loaded onto the trailer according to the Trailer Loading Section instructions, proceed to the installation site.

At the Installation Site, the cable reel covers are removed and the inside reel flanges are carefully inspected to insure that the surface is smooth and free from nails or other imperfections which will damage cable while unreeling.

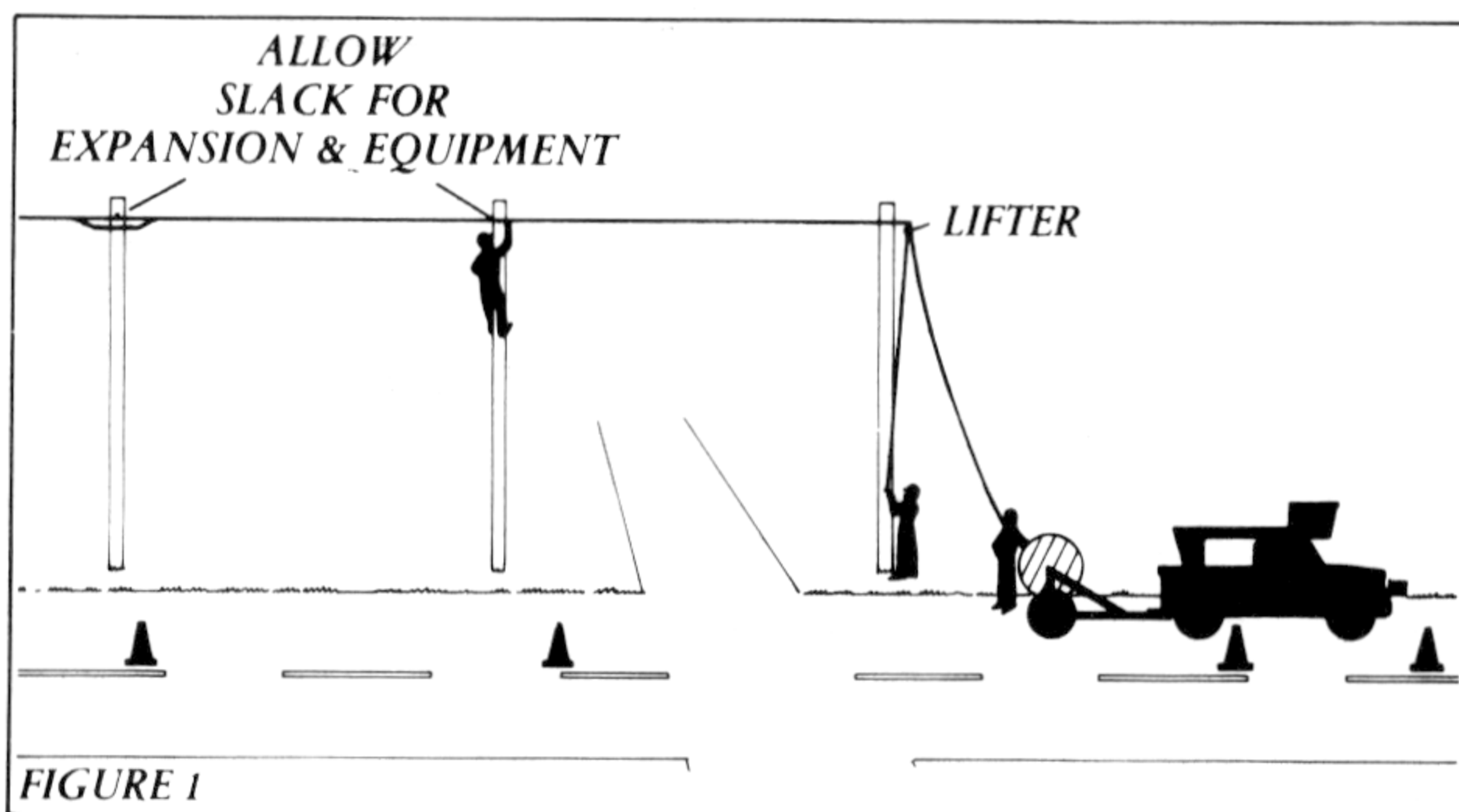
On drive off routes the cable will pay off the reels directly onto the pole line where it is to be attached. Therefore, follow these procedures:

The trailer is unhooked and appropriate safety equipment is placed along the route. The hardware selected for the project is attached to each pole by the crew members. As the hardware is placed, cable block rods are placed into the suspension clamps and a cable block (roller) is hung onto each rod.

If "J" hook hardware is used, then cable blocks (rollers) are only required at points of stress. After all of the hardware and cable rollers have been attached to the poles, the crew goes back to the cable trailer and reconnects it to the vehicle. The vehicle and trailer is pulled approximately 50 feet ahead of where the cable is to be attached to the first pole. A crew member then attaches the IM cable support strand or wire to the first pole's hardware.

The vehicle then pulls forward which places tension on the cable. As this occurs, the cable will start to unreel. As the vehicle proceeds to a point approximately 50 ft. ahead of the next pole attachment it stops and backs up to release tension on the cable. With a cable lifting tool, the cable is placed on the cable block of "J" hook previously installed. The vehicle and trailer then proceed to the next pole.

See Figure 1.



As the IM cable crosses intersections where the cable is subject to being hit by passing traffic, the crew members stop and temporarily sag the IM cable, then place and tighten the messenger or wire into the suspension clamp. This holds the cable up clear of the intersection during the balance of the stringing time.

When the cable has been unreeled to the end of the cable run according to instructions given above, the crew should attach a chain hoist and strand grip to the messenger portion of the IM cable and tension it so that all intersections are clear and so that the IM cable is suspended at a safe working height. The crew members then proceed back down the cable run to expansion loop locations and to all locations where equipment is to be spliced into the cable.

Another cable hoist with two strand grips are used to remove a portion of the messenger which will provide slack in the cable for forming expansion loops and extra cable needed to splice the equipment. A grip is placed on each side of the pole where the expansion loop or slack is required and with the hoist the messenger is tensioned until slack occurs. The webbing between the messenger and cable is then cut away between the two grips. A portion of the messenger is removed with bolt cutters. The amount of messenger to be removed is determined from the following messenger removal chart:

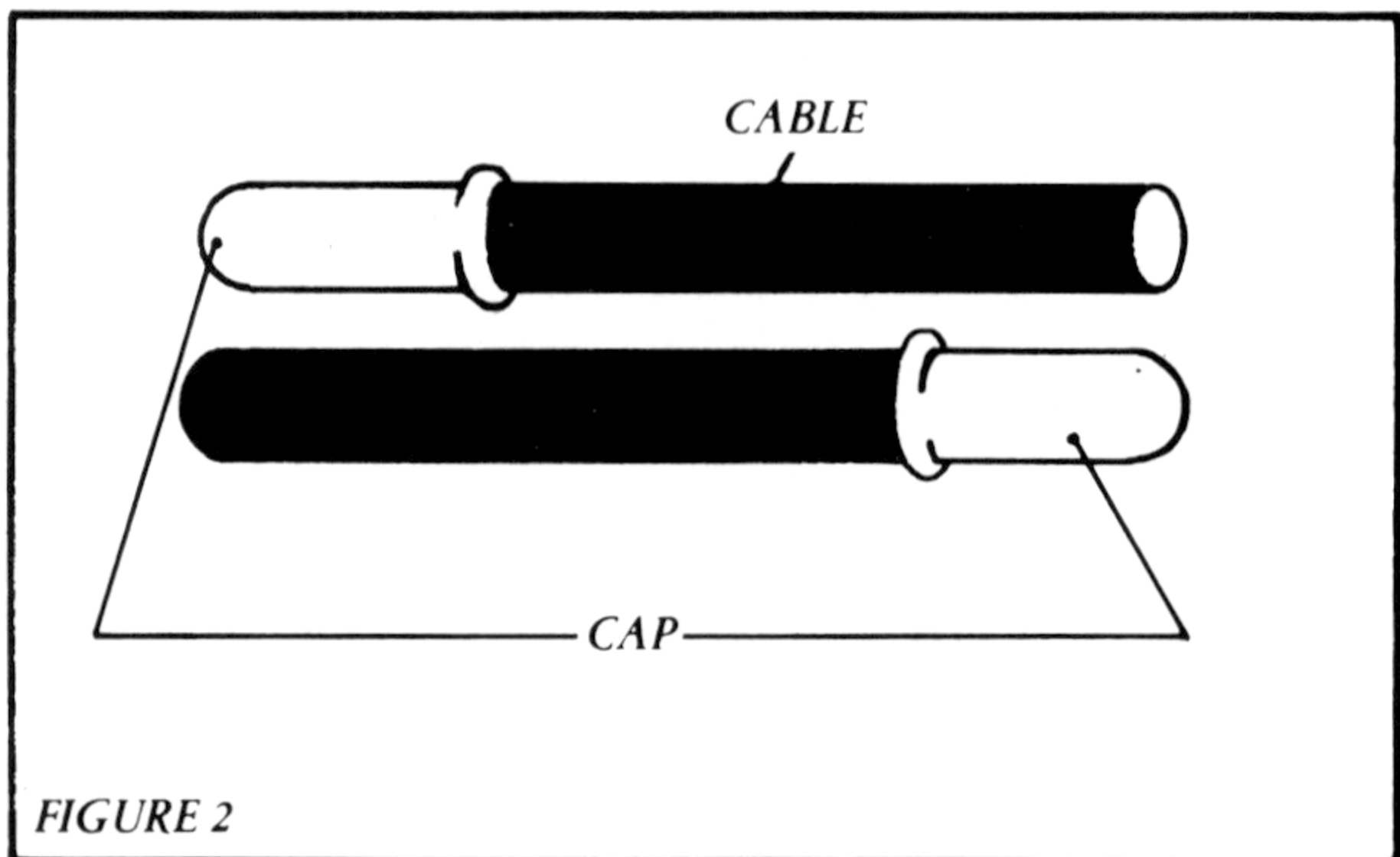
SLACK FOR EQUIPMENT - Cut and remove messenger equal to 100% of the desired slack.

EXPANSION LOOPS - Cut and remove messenger equal to 75% of the desired expansion loop depth.

After the appropriate length of messenger has been removed, a messenger splice is installed and tension on the messenger is released.

As portions of the messenger are removed for the expansion loops and/or slack for equipment installation, additional slack from the end of the route position is required. After all expansion loops and slack have been provided, the messenger is permanently attached at the end of the cable run. The crew members proceed back along the entire route, removing the cable blocks and block rods and placing the messenger into the suspension clamps to secure the IM cable in place. Each span is sagged for proper midspan clearance or in accordance with the Book of Tensioning Charts for IM Cable in the back of this section.

At the locations where the cable ends are cut to accommodate equipment, the cable protection caps are placed on the cable ends to protect the cable from the elements. See Figure 2.

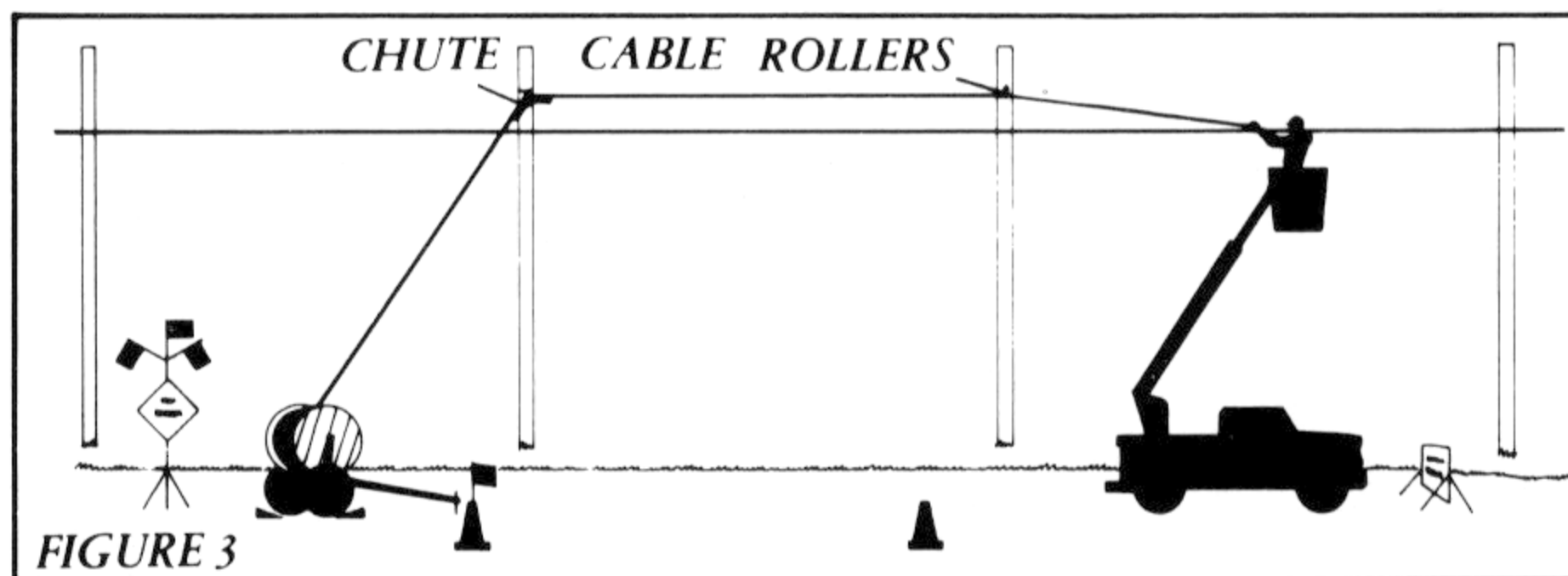


INSTALLATION PROCEDURES - BACK PULL ROUTES INTEGRAL MESSENGER (IM)

When the hardware materials have been selected and loaded and the IM cable to be placed has been loaded onto the trailer according to instructions in the Trailer Loading Section, proceed to the installation site. At the installation site, if the cable must be pulled into position over other existing facilities, backyard easements, or areas which are inaccessible by vehicles, follow these procedures.

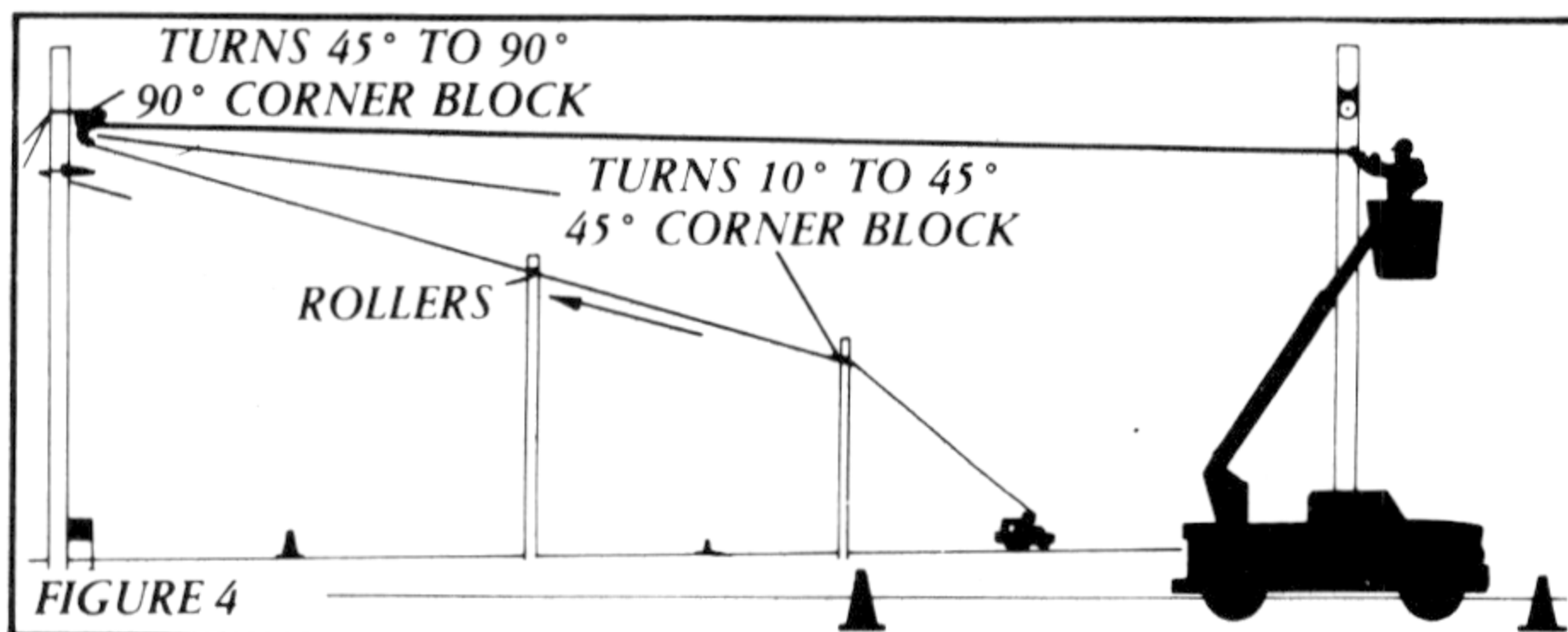
Appropriate safety equipment is placed along the route where the IM cable is to be attached to the poles.

The trailer is disconnected from the vehicle approximately 50 feet behind the beginning of the cable run. Hardware is placed on the first pole and the pole chute bracket is installed along with a 45° corner block. Hardware is attached to the poles in the balance of the run and cable block rods and cable blocks (rollers) are installed. Where “J” hook hardware is utilized, cable block rods and cable blocks are only required at points of stress. The crew then returns to the cable trailer location. See Figure 3.



A rotating eye pulling grip is placed on the messenger of the reel of IM cable to be pulled into place. A pulling line is attached to the swivel eye pulling grip and the cable is positioned across the cable chute rollers. The pulling line is connected to the vehicle and the IM cable is pulled into place span by span. As the cable passes each pole location, the tension is released and the IM cable is placed over the cable block or "J" hook with the cable lifting tool.

As the IM cable is pulled in at locations where the cable makes turns 10° to 45° , a 45° cable block assembly is installed on the strand or pole. The 90° cable block is utilized at all locations greater than 45° and up to 90° . The IM cable should not be pulled around more than one 90° turn. See Figure 4.



As the IM cable crosses intersections, crew members should be posted to watch the cable so that it is not hit by passing traffic. When the IM cable has been strung to the end of the cable run, the crew attaches the IM cable messenger to the dead pole hardware and places the anchor, downguy, ground rod, and band. The crew then returns to the cable trailer location. The crew members now attach a messenger grip to a pulling line. The pulling line is then placed across the rollers of the stationary chute and attached to the messenger approximately 20 ft. from the pole. The IM cable is partially sagged with the pulling line while all excess cable is re-rolled onto the cable reel. A chain hoist and strand grip is attached to the messenger portion of the IM cable and it is tensioned so that all intersections are clear and so that the IM cable is suspended at a safe working height. The crew now proceeds back down the cable run to expansion loop locations or locations where equipment is to be spliced into the cable. The procedures for providing expansion loops and slack for splicing in equipment described on page IM-13 of this section are then followed.

INSTALLATION PROCEDURES - BACK PULL - WINCH INTEGRAL MESSENGER CABLE (IM)

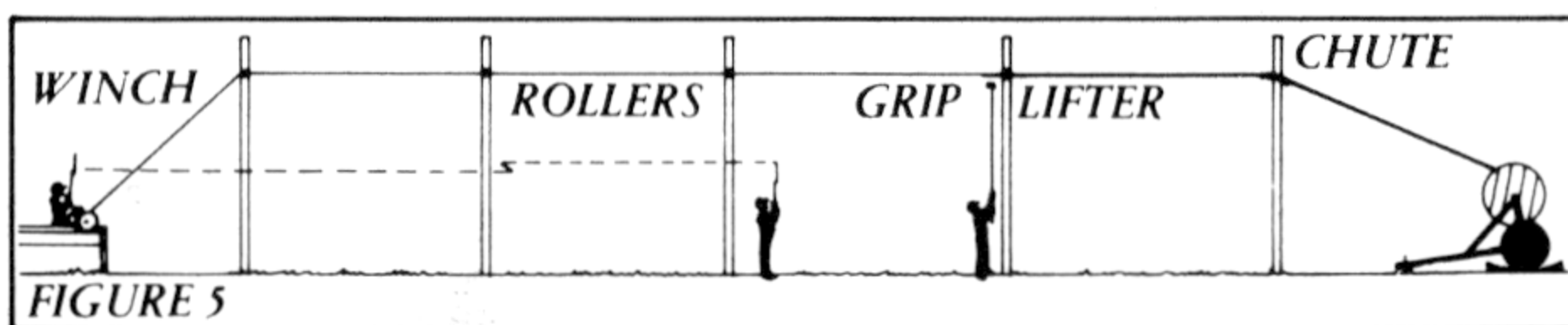
If conditions dictate that the length of the route being pulled requires the use of the winch, the following procedures are followed:

The trailer is disconnected from the truck approximately 50 ft. behind the beginning of the cable run. The hardware, anchor, downguy and bond is placed on the first pole and the pole chute bracket is installed along with a 45° corner block. Additional hardware is attached to the poles in the balance of the route along with cable blocks (rollers) and cable block rods. All 45° and 90° cable blocks (rollers) are also installed.

From the anticipated end of the run, the winch is set up and adjusted toward the cable run. The winch cable is then strung along the cable run and placed over all the cable blocks (rollers) at all non-stress locations. The winch line should run across steel winch line blocks (rollers) at all corners and other points of stress to avoid damage to the rubber or plastic rollers that are used in the cable roller blocks.

After the winch line has been connected to the rotating “eye” pulling grip which is attached to the messenger of the IM cable, and after the cable has been placed across the rollers of the stationary chute, the winch operator tensions the winch line. The reel brake on the cable trailer is adjusted so that the pulling tension of the cable does not exceed recommended pulling tension per individual cable specifications.

A dynamometer is utilized on all long cable pulls or where the tension on the cable might exceed the specifications. The cable is pulled into place with the winch, span by span, to the point where the cable run ends. As the cable passes the pole locations where the winch line is running across the steel winch line blocks, tension on the winch line is reduced slightly and the coax is placed in the rolling blocks. See Figure 5.

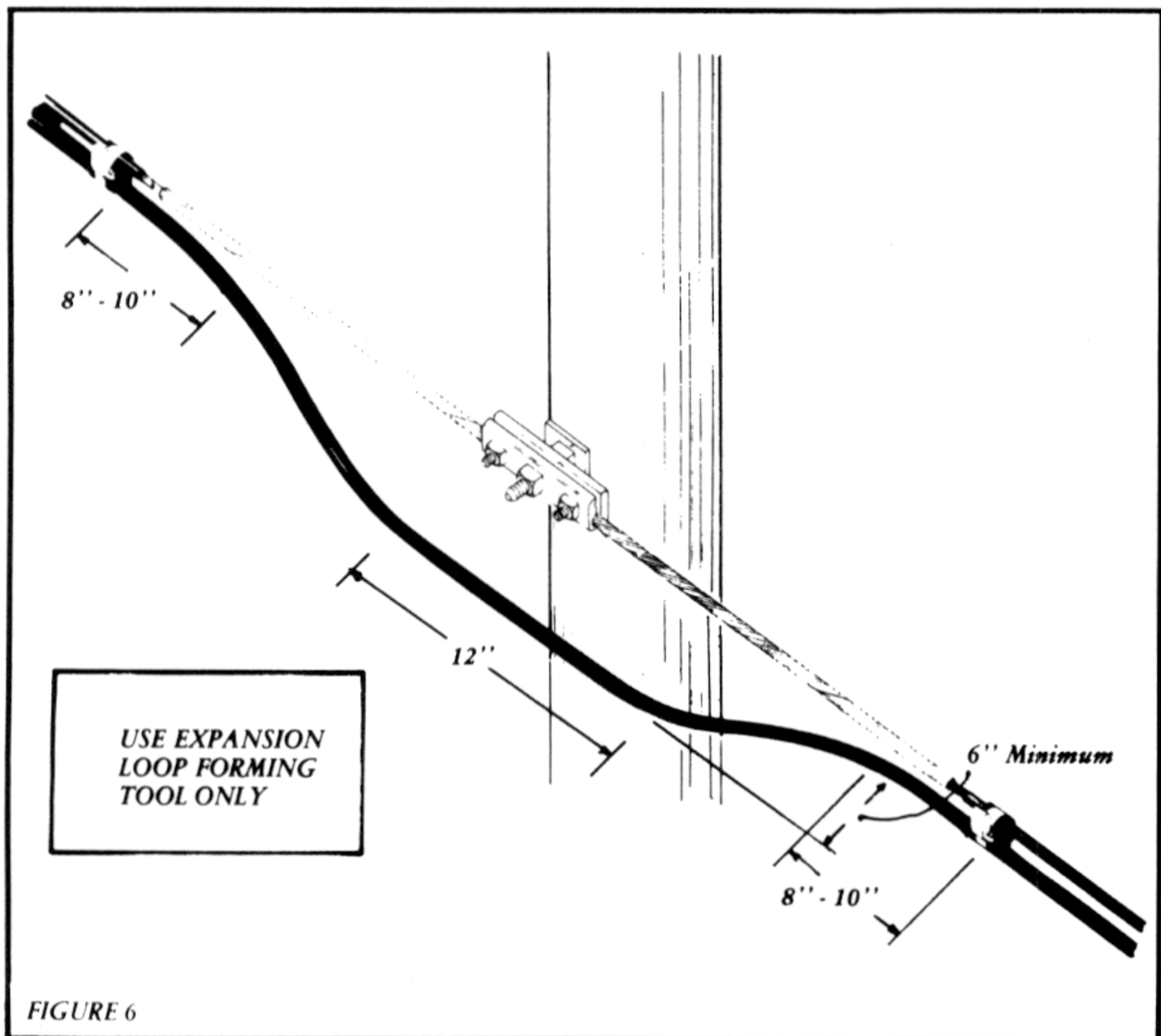


There should be adequate personnel in communication with the winch operator to watch the cable as it is being pulled into place. When the winch has pulled the IM cable to the end of the cable run, the IM cable slack and expansion loops are cut into poles the same as described per the instructions on page IM-13.

INSTALLATION PROCEDURES - EXPANSION LOOP

To allow for maximum temperature extremes, expansion loops are placed at each pole and at the input and output of all equipment. For locations where maximum temperature variations are not anticipated, users may modify the number and placement of loops based on their evaluations of installations in similar locations and under similar conditions.

In all cases, expansion loops should always be formed with a tool designed for the purpose and never by hand. See Figure 6.



INSTALLATION PROCEDURES - MULTIPLE CABLES

In locations where more than one cable is required, there are two procedures which should be followed:

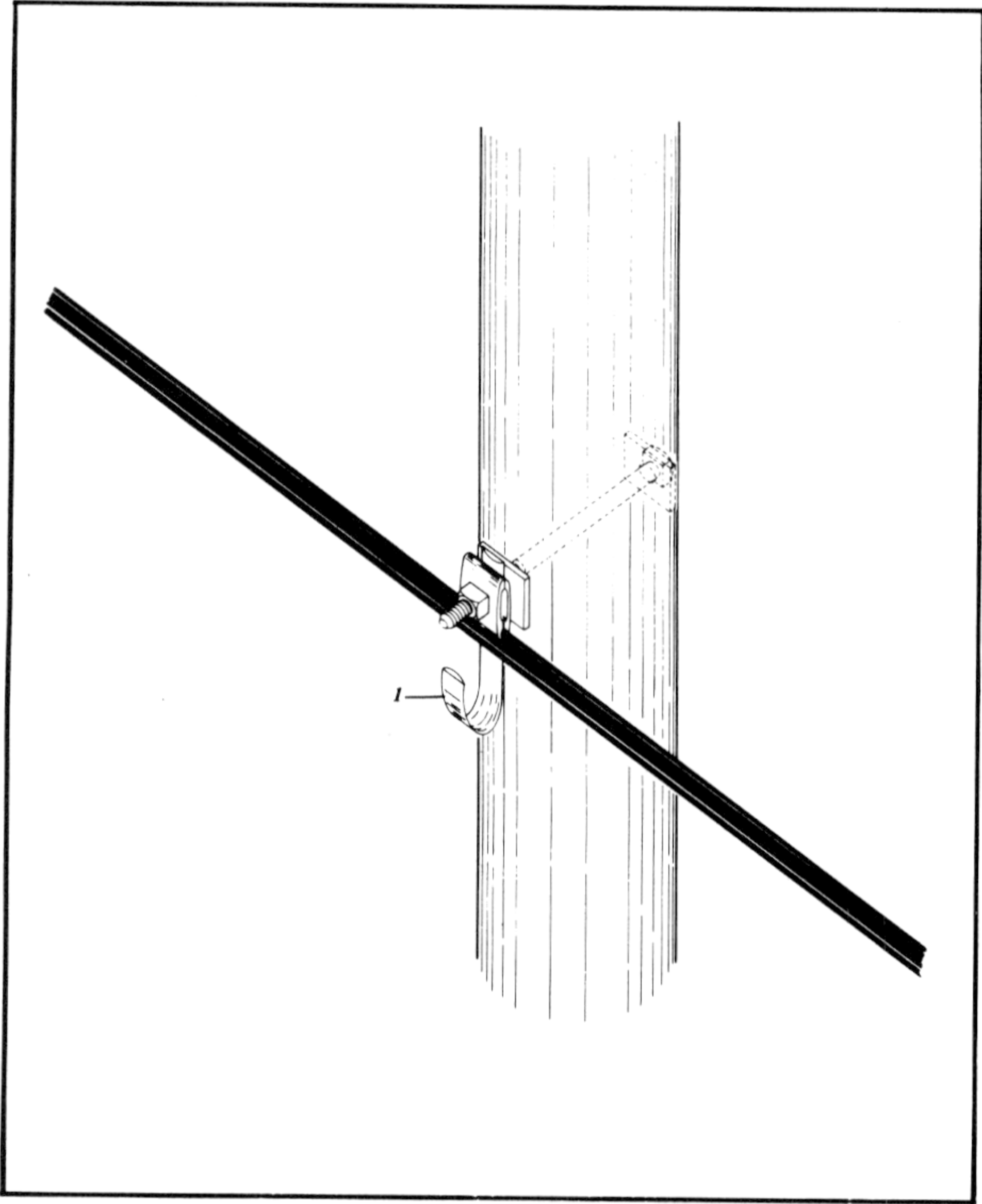
(1) After the IM cable installation has been completed, additional cables may be lashed to it. The number and sizes of cables that the IM cable can accommodate is determined by the size of the messenger strand of wire used when the IM cable is manufactured.

(2) Do not install IM cables in the areas requiring multiple cables. Instead, place separate messenger strand or wire then lash the multiple cables required to the separate messenger.

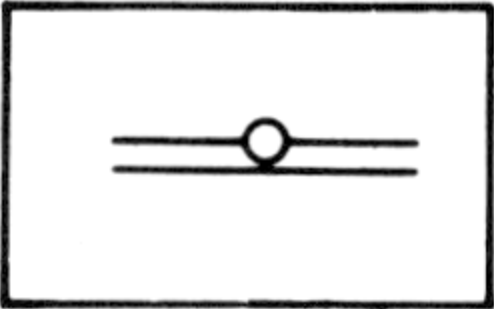
After selecting the method to be used for placement of the multiple cables, the instructions contained in the "CABLE HANDLING AND INSTALLATION PROCEDURES - LASHED CABLE" is followed.

CABLE HANDLING AND INSTALLATION PROCEDURES
INTEGRAL MESSENGER IM
POLE FRAMING ILLUSTRATIONS

	Page
Figure IM-1 Cable Placing-Straight Line	IM-56
Figure IM-2 Cable Placing-Straight Line— Steel or Concrete Pole	IM-57
Figure IM-3 Cable Placing-Angle Pole	IM-58
Figure IM-4 Cable Placing-Straight Line Pole Cross-Over	IM-59
Figure IM-5 Cable Placing-Mid-Span Cross-Over	IM-60
Figure IM-6 Cable Placing-False Dead-End	IM-61
Figure IM-7 Cable Placing-Line Pole Dead-End Combination No. 1	IM-62
Figure IM-8 Cable Placing-Line Pole Dead-End Combination No. 2	IM-63
Figure IM-9 Cable Placing-Dead-End	IM-64
Figure IM-10 Cable Placing-Double Dead-End	IM-65
Figure IM-11 Hardware	IM-66

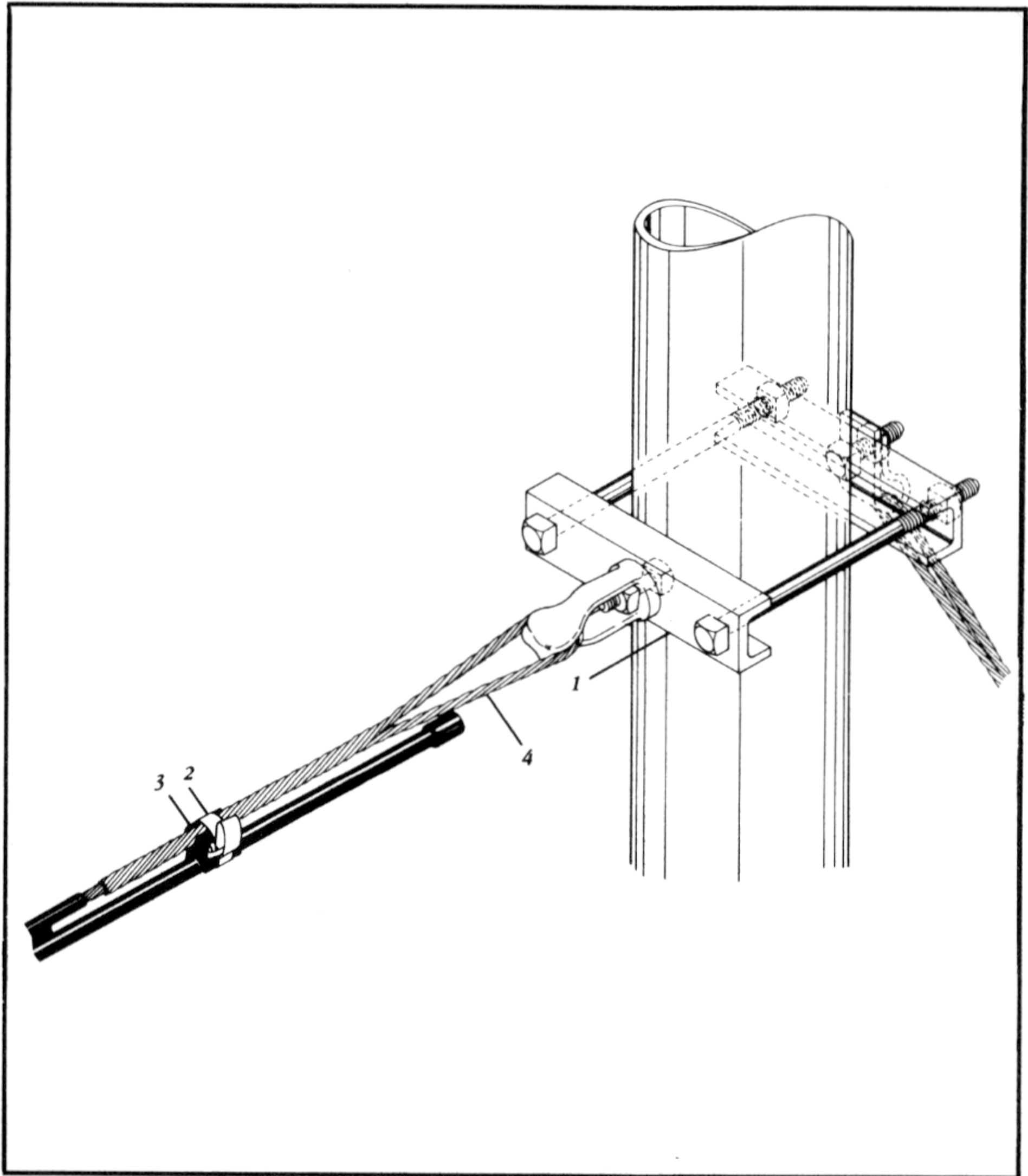


Map Legend



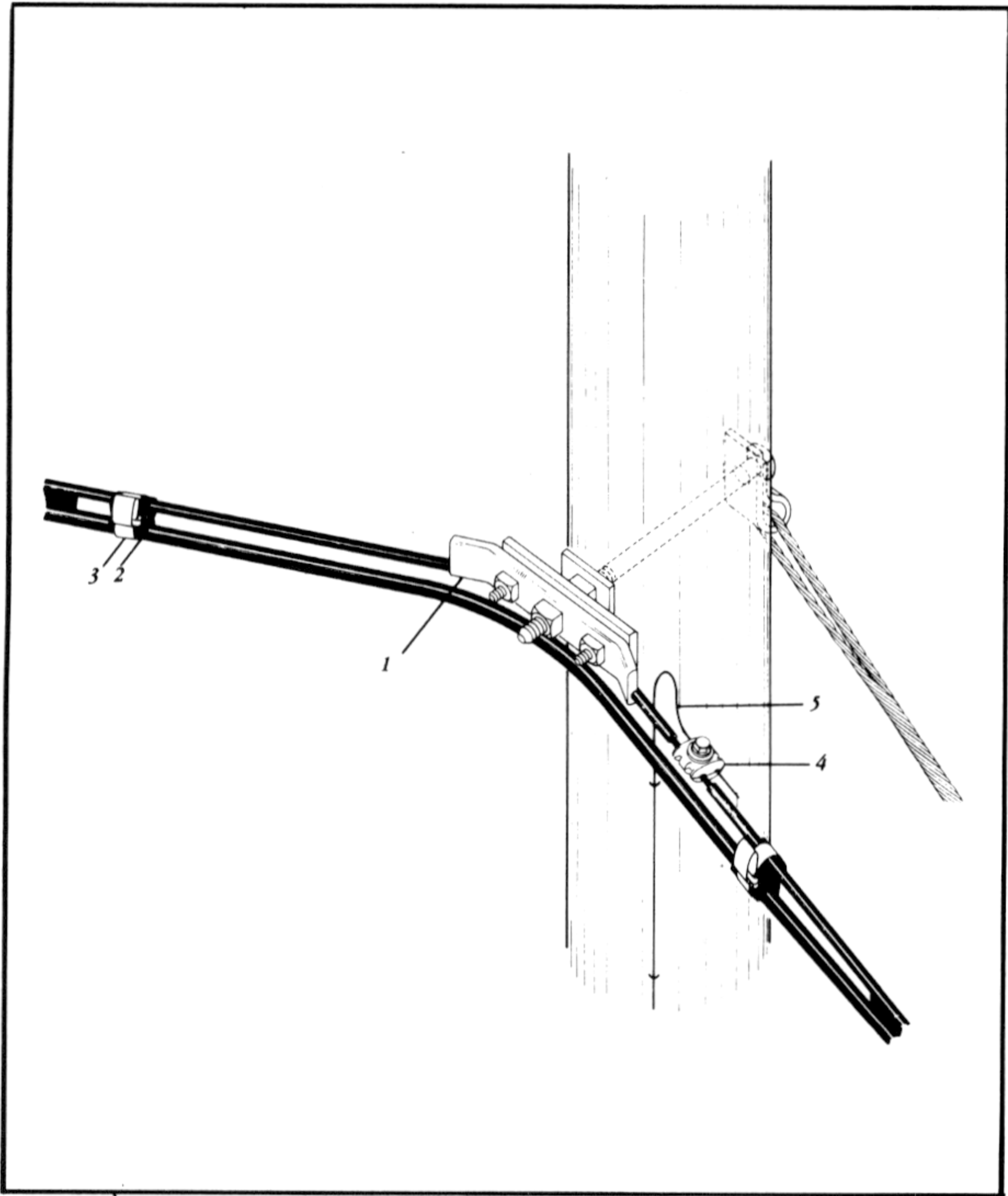
<i>Item</i>	<i>Description</i>
<i>1</i>	<i>J Hook Clamp Hardware</i>

FIGURE IM-1 IM CABLE PLACING - STRAIGHT LINE

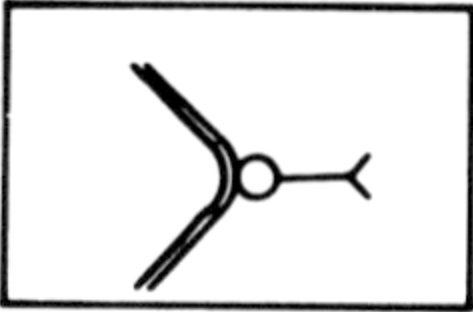


<i>Item</i>	<i>Description</i>
1	Dead End Clamp Bracket
2	Cable Spacer
3	Strap (Steel or concrete pole)
4	Dead End Clamp

FIGURE IM-2 **IM CABLE PLACING - DEAD END**

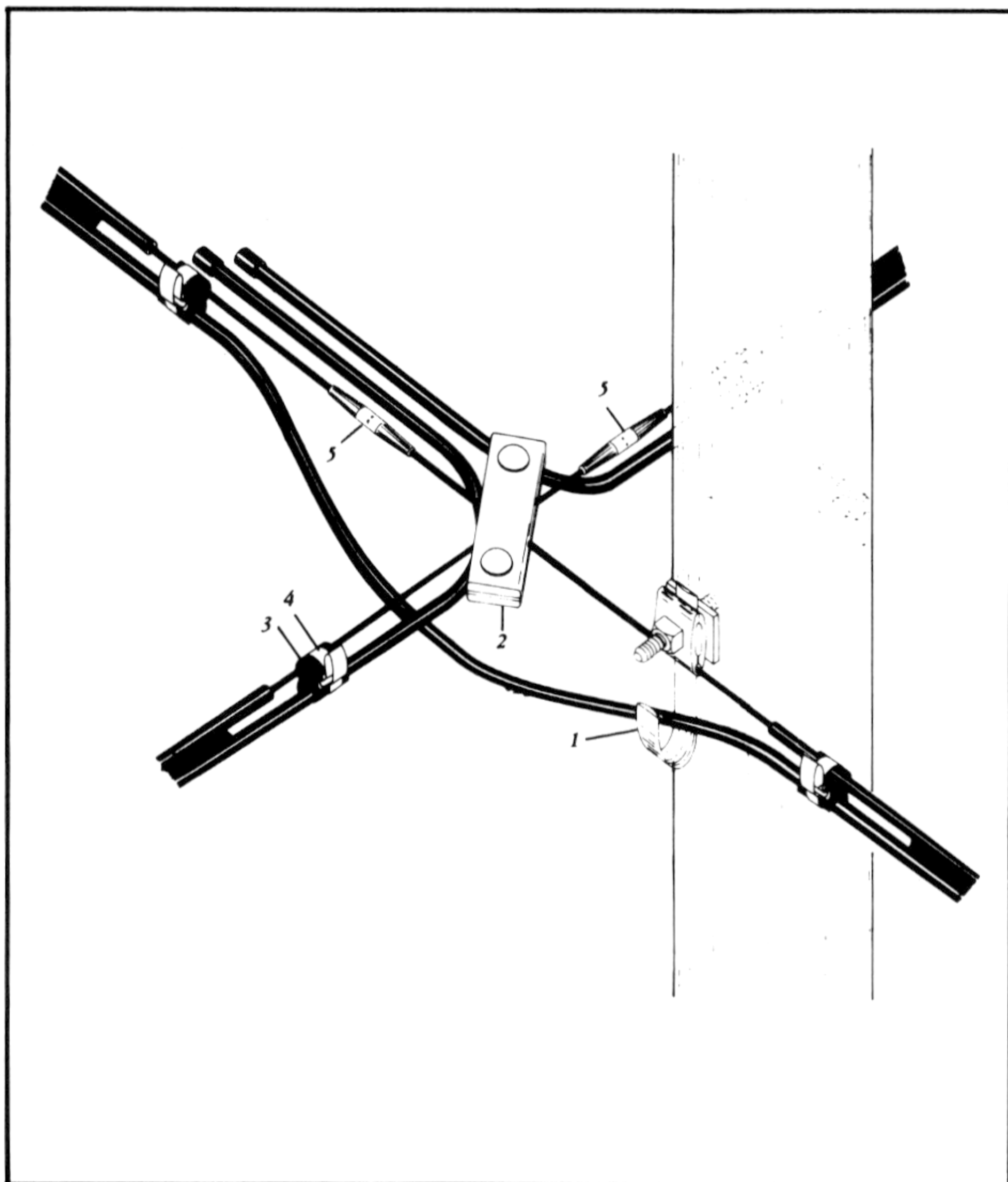


Map Legend



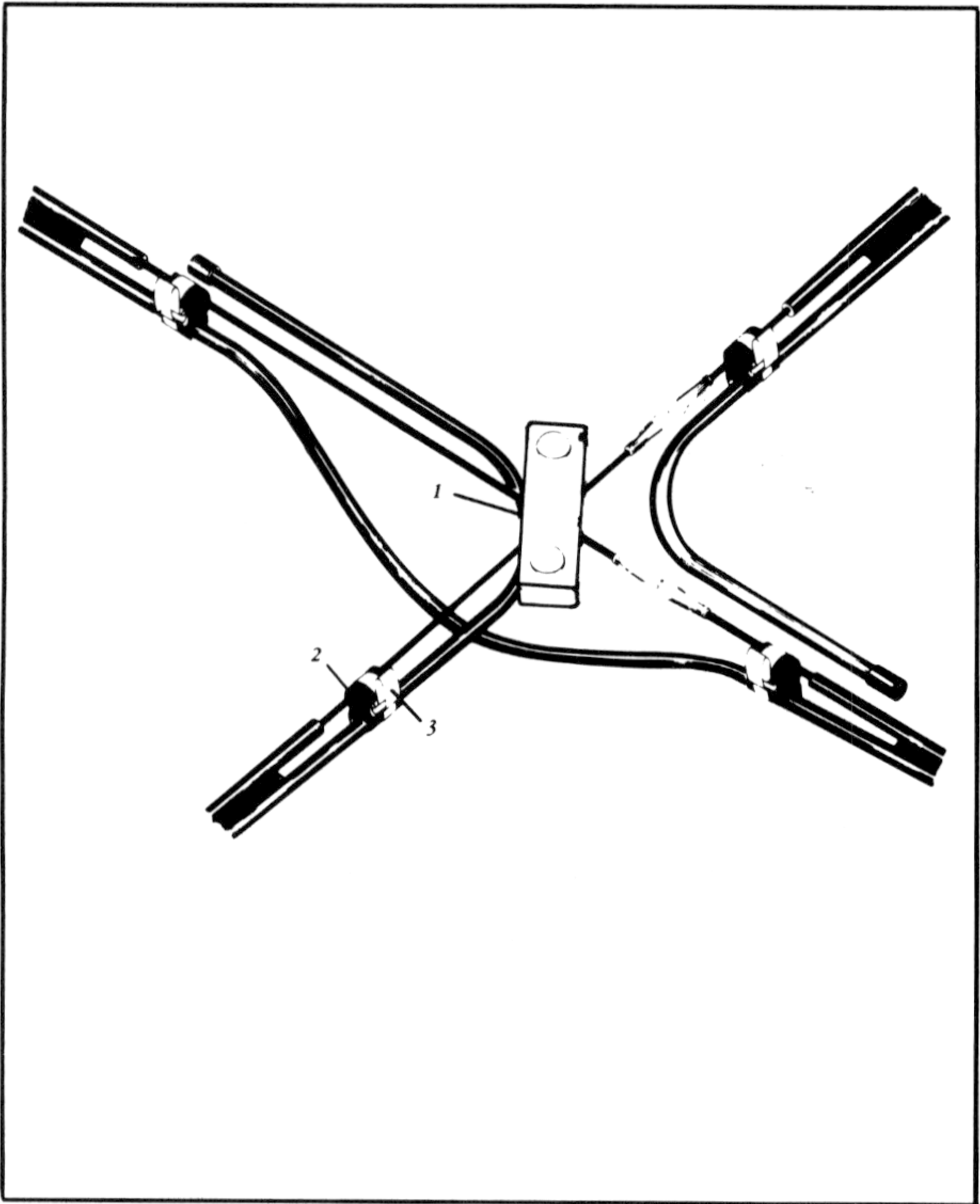
<i>Item</i>	<i>Description</i>
1	3 Bolt Curve Clamp Hardware
2	Cable Spacer
3	Cable - Support Strap
4	Bonding Clamp
5	Ground Wire

FIGURE IM-3 CABLE PLACING - ANGLE POLE



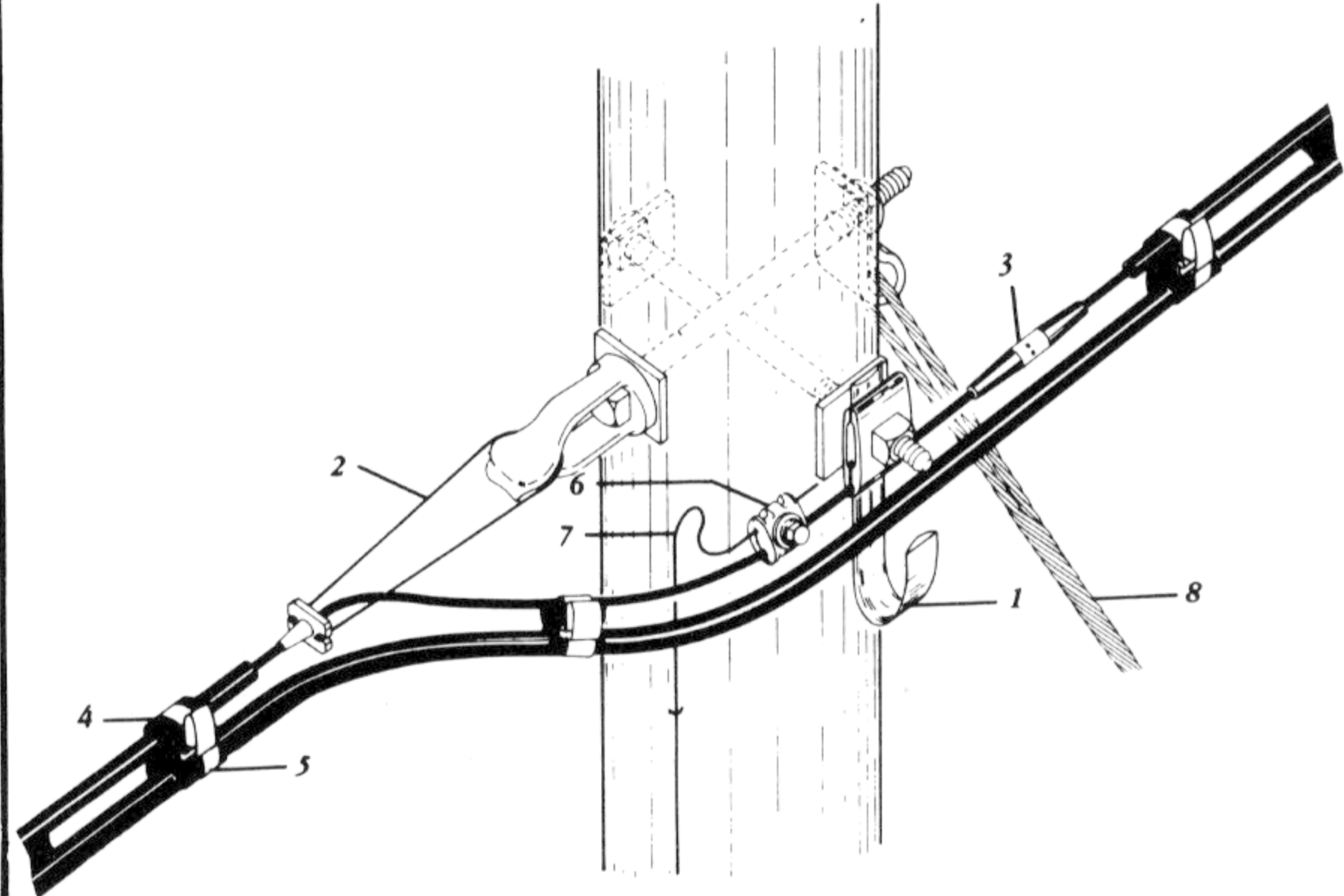
<i>Item</i>	<i>Description</i>
1	'J' Hook
2	Cross-Over Clamp
3	Cable Spacer
4	Cable Support Strap
5	Messenger Splice

**FIGURE 1M-4 CABLE PLACING - STRAIGHT LINE
POLE CROSS-OVER**

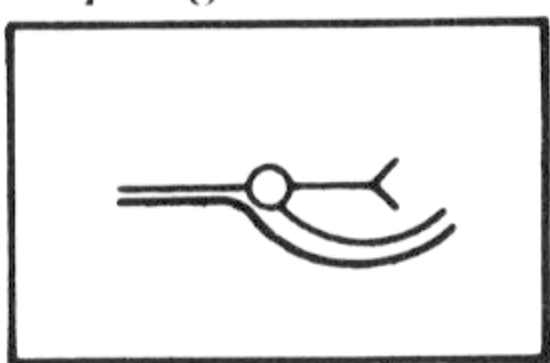


<i>Item</i>	<i>Description</i>
1	<i>Crossover Clamp Hardware</i>
2	<i>Cable Spacer</i>
3	<i>Cable Support Strap</i>

FIGURE IM-5 CABLE PLACING - MID-SPAN CROSSOVER

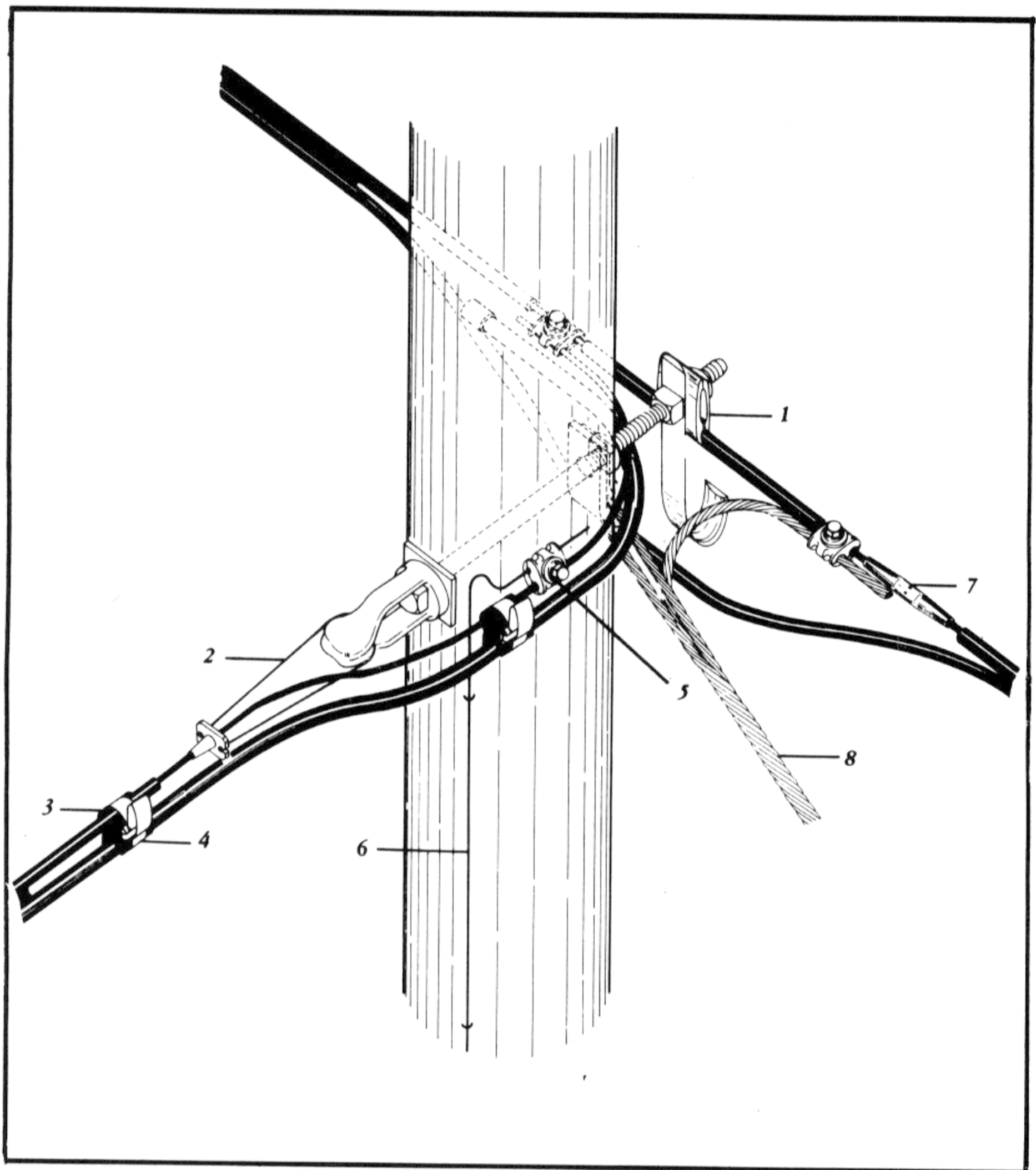


Map Legend

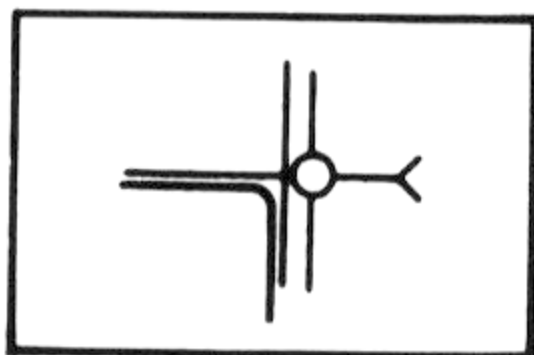


<i>Item</i>	<i>Description</i>
1	<i>J Hook Clamp - Dead End Hardware</i>
2	<i>Messenger Dead End</i>
3	<i>Messenger Splice</i>
4	<i>Cable Spacer</i>
5	<i>Cable Support Strap</i>
6	<i>Bonding Clamp</i>
7	<i>Ground Wire</i>
8	<i>Down Guy</i>

FIGURE IM-6 CABLE PLACING - FALSE DEAD-END

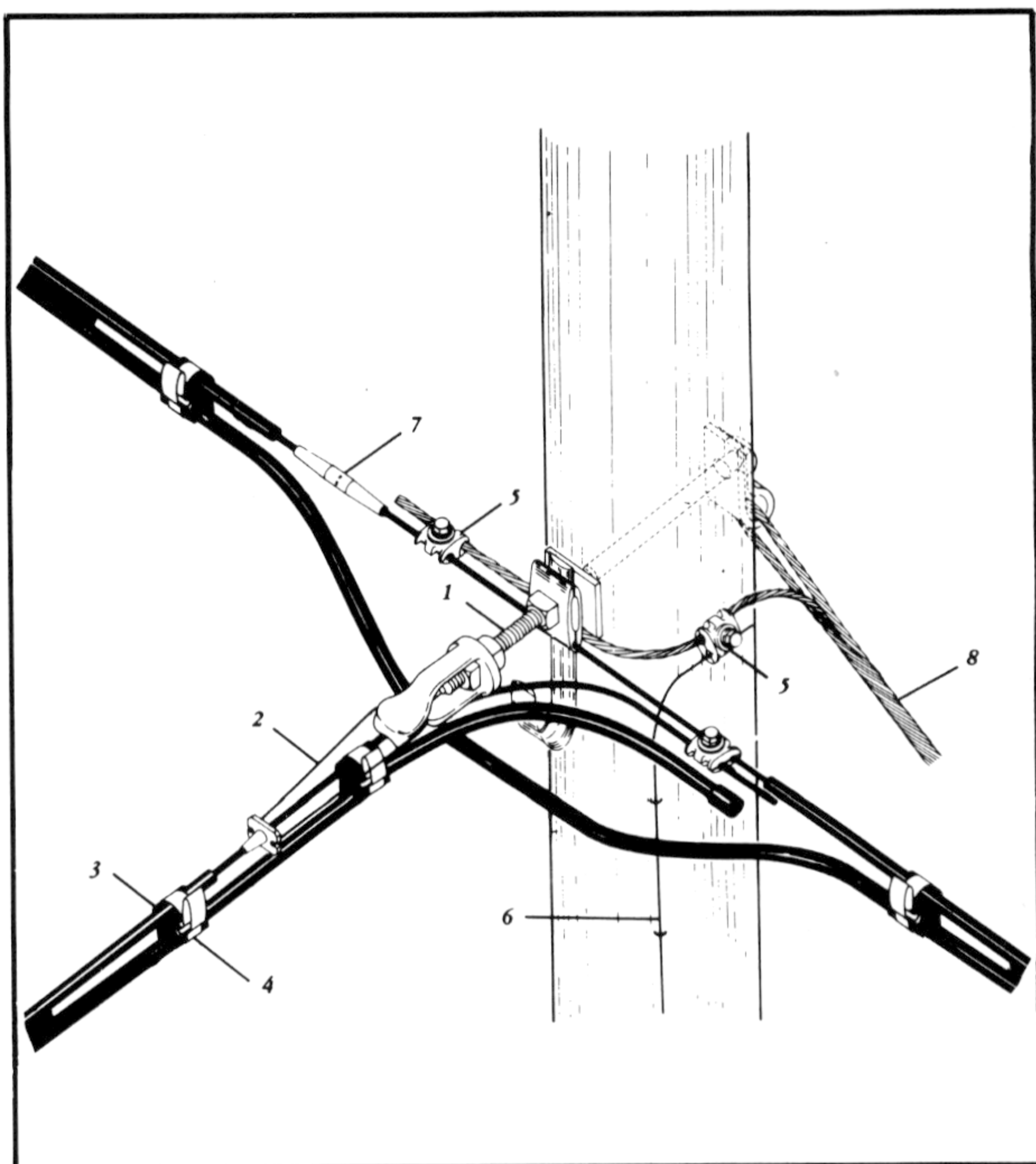


Map Legend

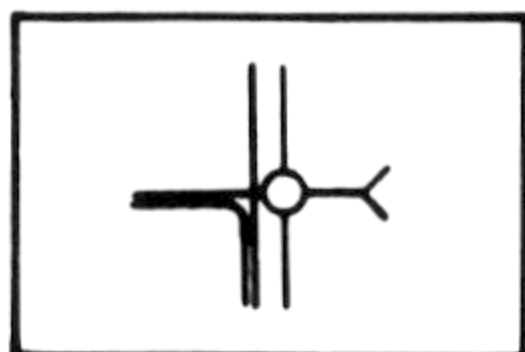


<i>Item</i>	<i>Description</i>
1	<i>J Hook Clamp - Dead End Hardware</i>
2	<i>Messenger Dead End</i>
3	<i>Cable Spacer</i>
4	<i>Cable Support Strap</i>
5	<i>Bonding Clamp</i>
6	<i>Ground Wire</i>
7	<i>Messenger Splice</i>
8	<i>Down Guy</i>

FIGURE IM-7 CABLE PLACING - LINE POLE DEAD-END COMBINATION No. 1

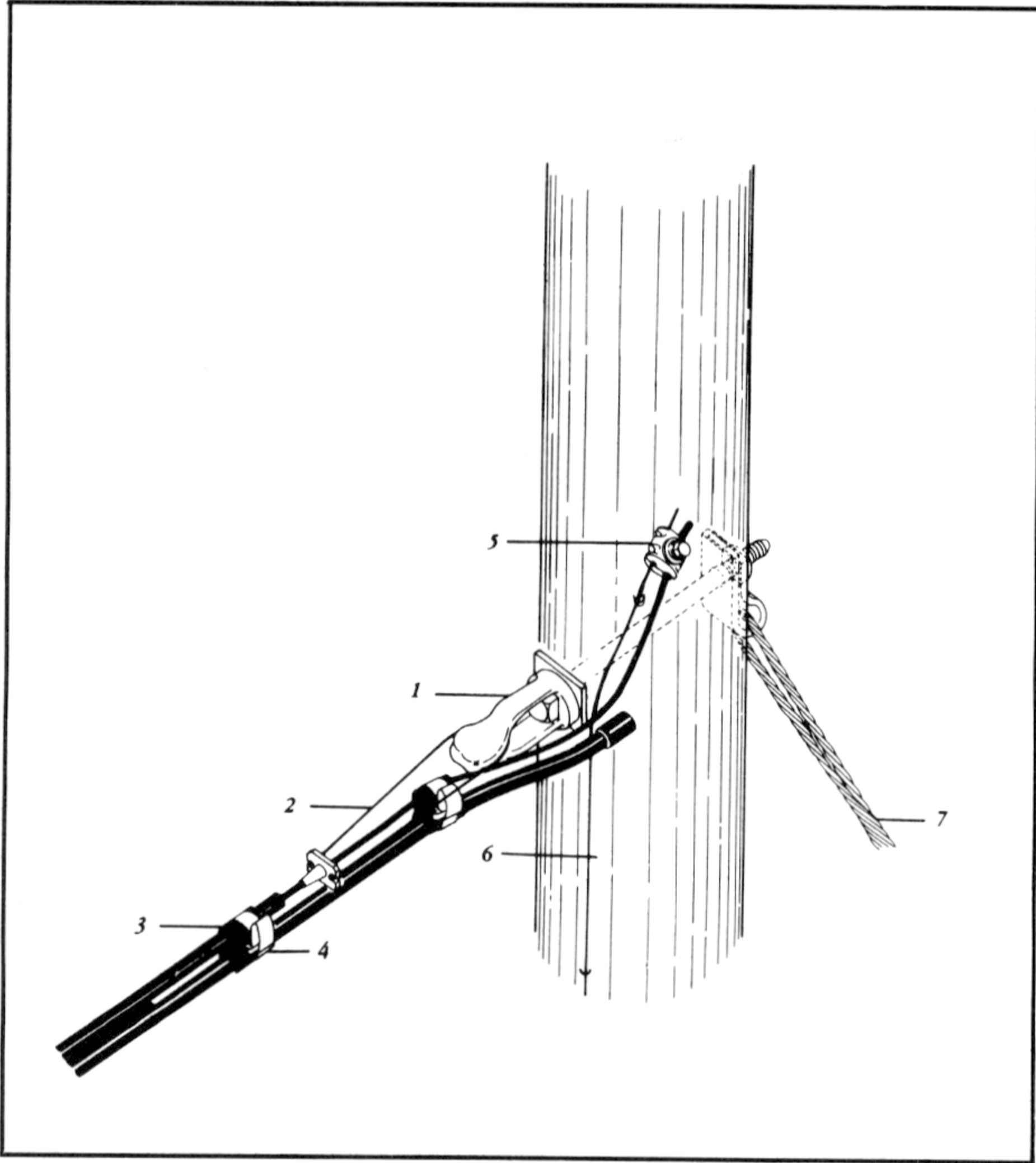


Map Legend

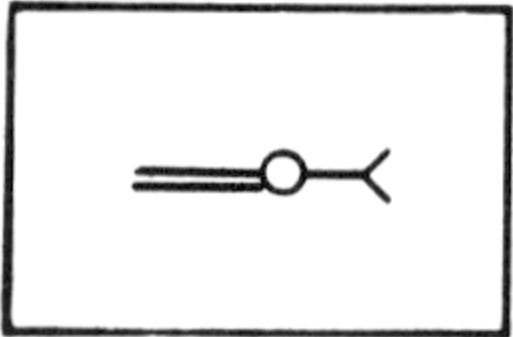


<i>Item</i>	<i>Description</i>
1	J Hook Clamp
2	Messenger Dead End
3	Cable Spacer
4	Cable Support Strap
5	Bonding Clamp
6	Ground Wire
7	Messenger Splice
8	Down Guy

**FIGURE IM-8 CABLE PLACING - LINE POLE DEAD-
END COMBINATIONS No. 2**

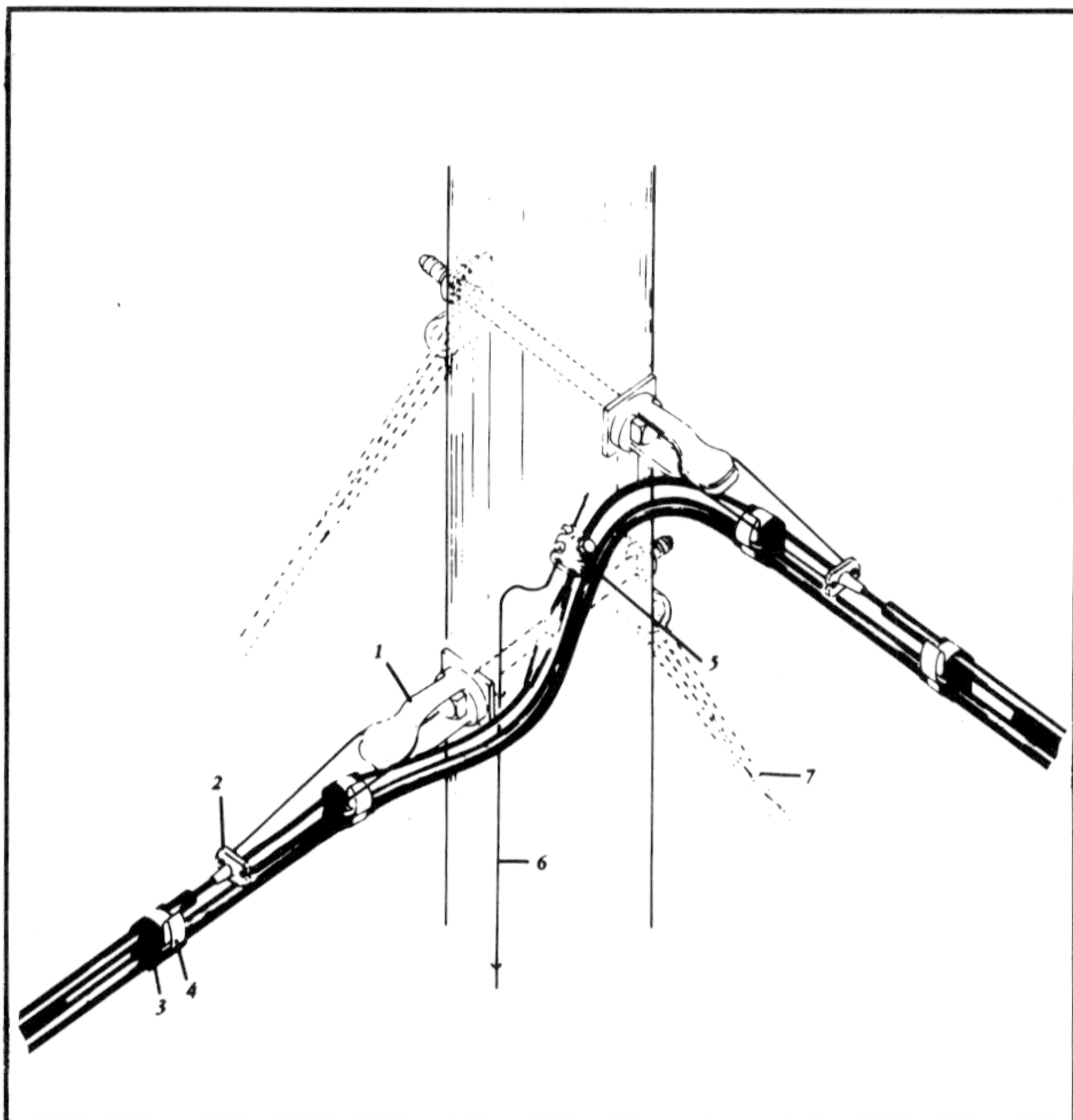


Map Legend



<i>Item</i>	<i>Description</i>
1	<i>Dead-End Hardware</i>
2	<i>Messenger Dead End</i>
3	<i>Cable Spacer</i>
4	<i>Cable Support Strap</i>
5	<i>Bonding Clamp</i>
6	<i>Ground Wire</i>
7	<i>Down Guy</i>

FIGURE IM-9 CABLE PLACING - DEAD-END

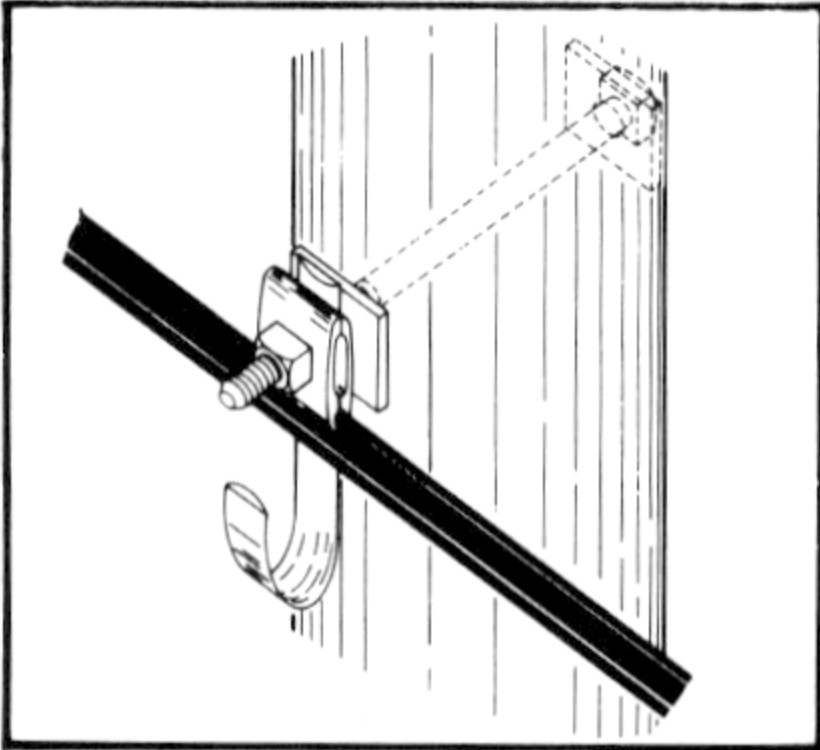


<i>Item</i>	<i>Description</i>
1	<i>Double Dead-End Hardware</i>
2	<i>Messenger Dead End</i>
3	<i>Cable Spacer</i>
4	<i>Cable Support Strap</i>
5	<i>Bonding Clamp</i>
6	<i>Ground Wire</i>
7	<i>Down Guy</i>

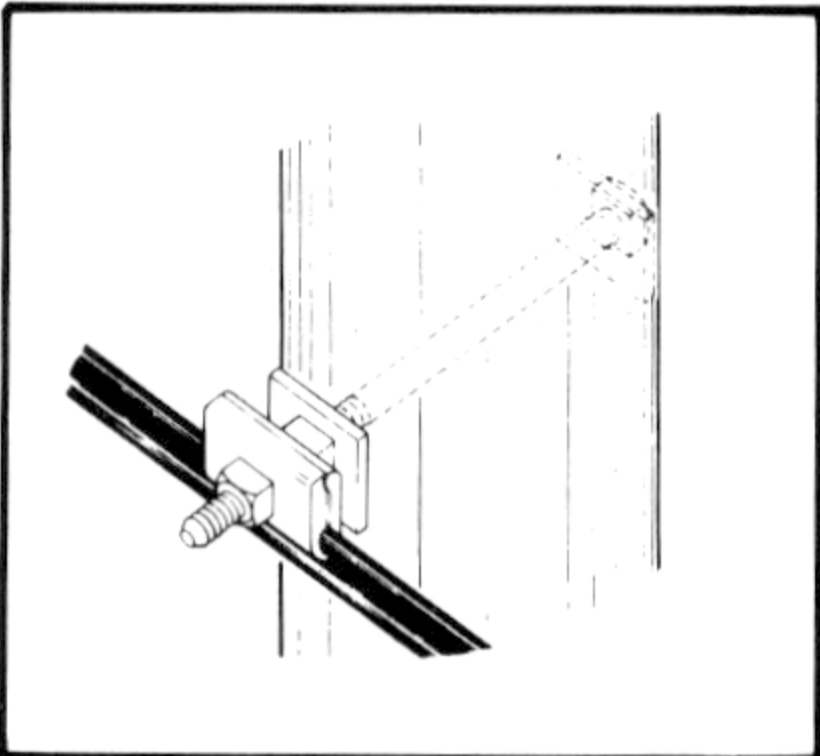
FIGURE IM-10 CABLE PLACING - DOUBLE DEAD-END

INTEGRAL MESSENGER (IM) HARDWARE

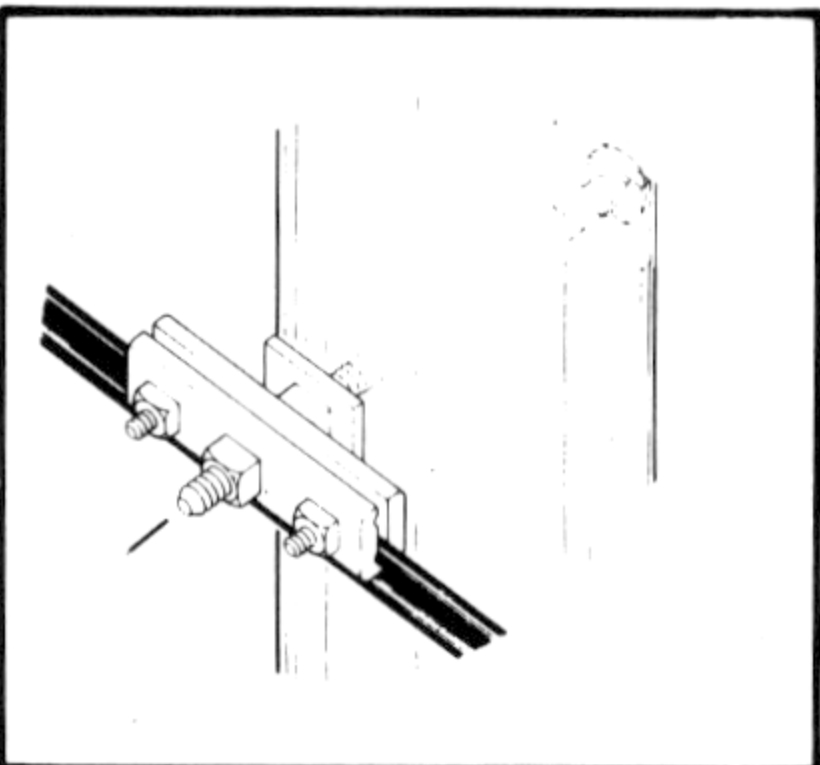
There are three basic sets of hardware generally used to support integral messenger (IM) cables. They are as follows:



1. J. Hook with Suspension Clamp



2. 1 Bolt Suspension Clamp



3. Three (3) Bolt Suspension Clamp

FIGURE 11

The hardware selected is determined by the sizes and weight of integral messenger cables to be installed.

Cable Handling and Installation Procedures Lashed Cable

CABLE HANDLING AND INSTALLATION PROCEDURES DRIVE OFF ROUTES - LASHED CABLE

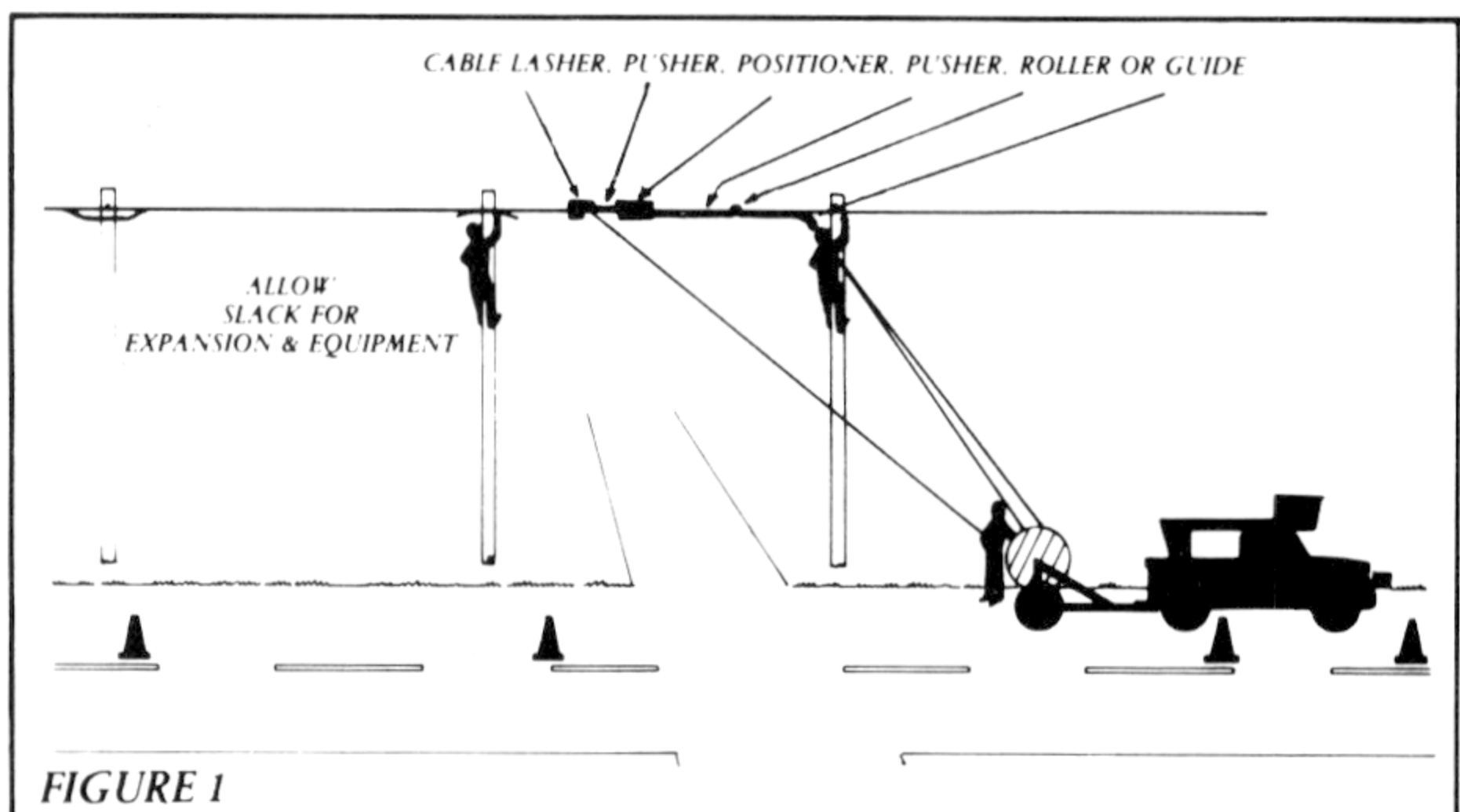
When the tools have been selected, after reviewing the Tool Section, and the cable reels to be placed have been loaded onto the trailer according to the Trailer Loading Section instructions, proceed to the installation site.

At the installation site, on routes where the cable will pay off the reels directly into the pole line, use the following installation procedures. See Figure 1.

While appropriate safety equipment is placed along the route where the cable is to be attached to the strand, a crew member removes the cable reel covers and inspects the inside reel flanges to ensure that the surfaces are smooth and free from nails or other imperfections which will damage the cable while unreeling.

Pushers, positioners and guides are placed on the strand by a crew member at the first pole in the route. The vehicle and reel trailer is moved approximately 50 feet down the route from this pole and the cable is unreeled and fed through the guide, positioner and lashing machine to the pole. The lashing wire is placed around the tension rollers on the lasher and attached to the lashing wire clamp. Pull ropes are attached to the guides, positioners and lasher and attached to the vehicle.

While a crew member holds the cable(s) at the pole, the vehicle moves slowly forward pulling the lasher and accessories along the strand. The lashing machine wraps lashing wire around the cable and strand which attaches them together. See Figure 1.

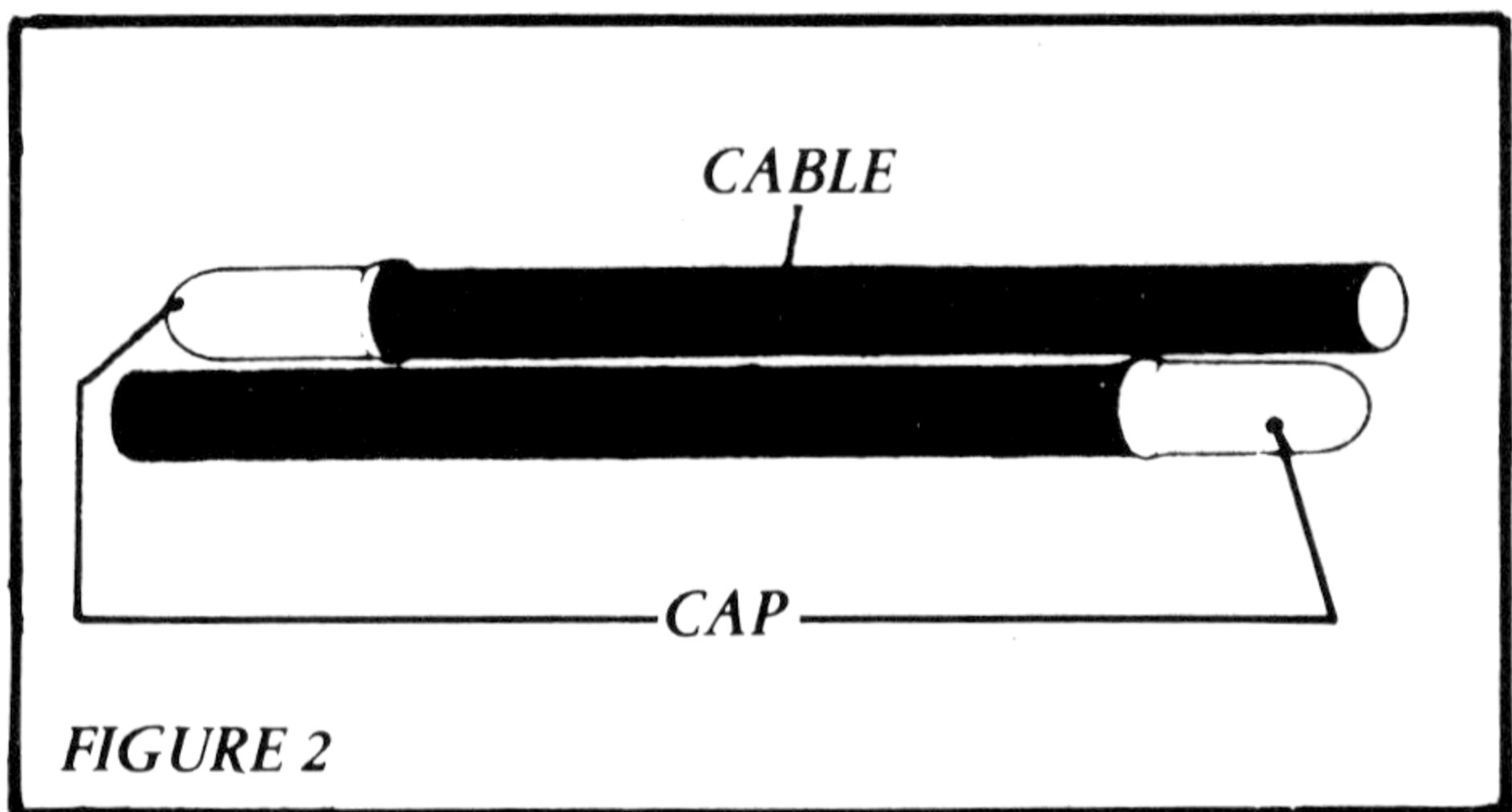


The cable reel trailer and truck is always approximately 50 feet ahead of the location where the cables are being fed into the guide on rollers. The tension on the cable should be such that the cable flows easily through the cable guide and/or rollers. Determine from individual cable specification sheets the maximum recommended pulling tension.

When the lasher and accessories reach the next pole in the route, the vehicle and reel trailer stops. A crew member temporarily clamps the lashing wire to the strand and transfers the lasher and accessories to the other side of the pole, the crew member uses an expansion loop tool to form an expansion loop in the cable, then attaches the lashing wire out of the lasher to a lashing wire clamp, then holds the cable while the vehicle and reel trailer moves slowly forward lashing the next span of cable to the strand. The crew member then releases the cable, makes the temporary lashing wire clamp permanent and installs the cable spacers and aerial cable support straps. The crew member then moves to the next pole and repeats this work function.

This process continues until the entire cable route has been lashed.

At all locations where the cable ends are cut to accommodate equipment, the cable protective caps are placed on the cable ends to protect the cable from the elements. See Figure 2.



Each additional drive-off cable route is completed according to the procedures given above.

INSTALLATION PROCEDURES - BACK PULL ROUTE - LASHED CABLE

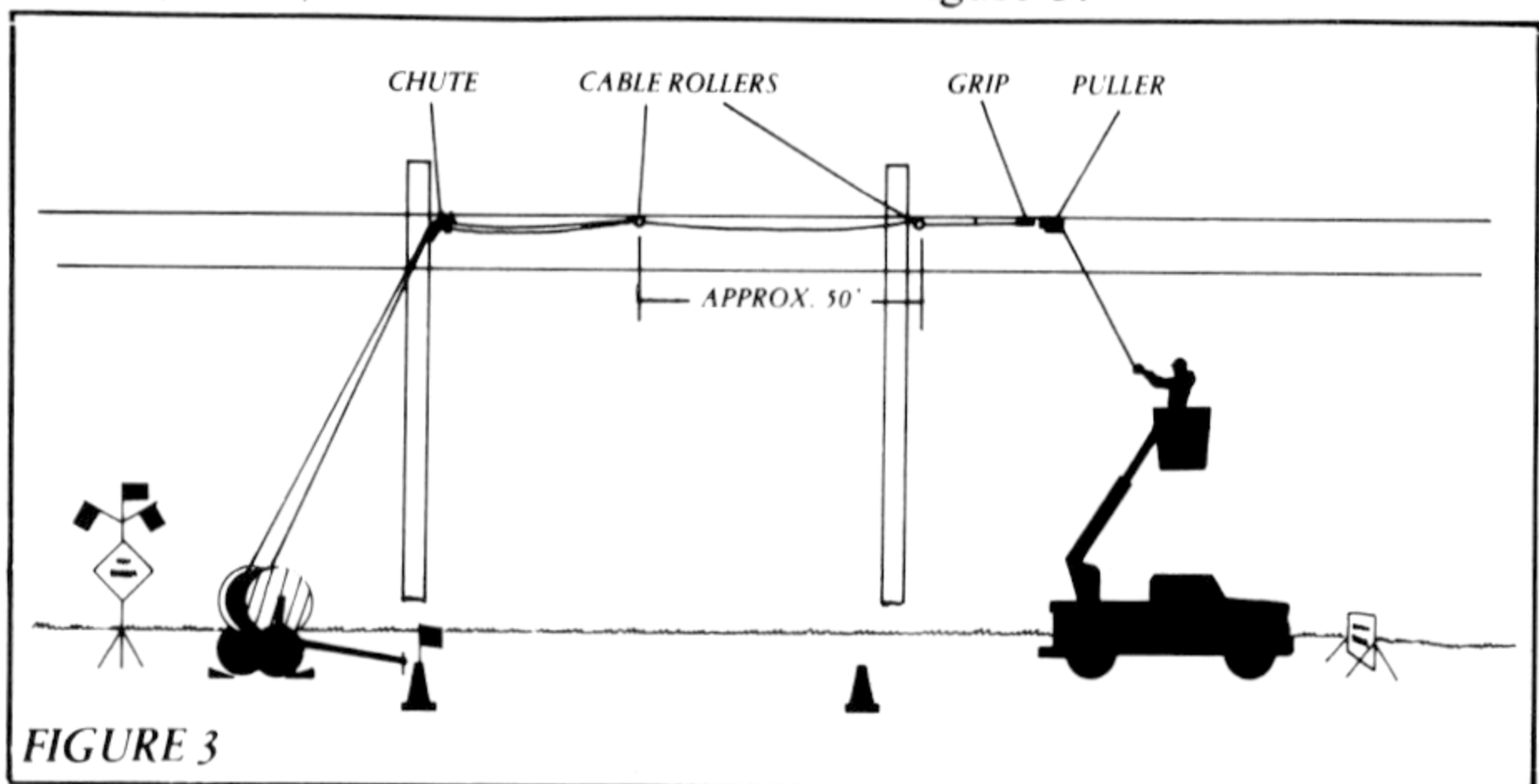
When the tools have been selected, after reviewing the Tool Section, and the cable reels to be placed have been loaded onto the trailer according to the Trailer Loading Section instructions, proceed to the installation site.

At the installation site, where the cable route is back pull, or where the cable(s) must be pulled into position over other existing facilities, backyard easements, or areas which are inaccessible by vehicles, follow these procedures:

The cable reel trailer is unhooked from the truck and the tongue of the trailer positioned so that it points toward the pole or location where the cable is to pay off the reels into the stationary chute or rollers. The trailer should be approximately 50 feet away from this location with the trailer wheel chocks in place. All safety equipment should be distributed along the route for safe working conditions.

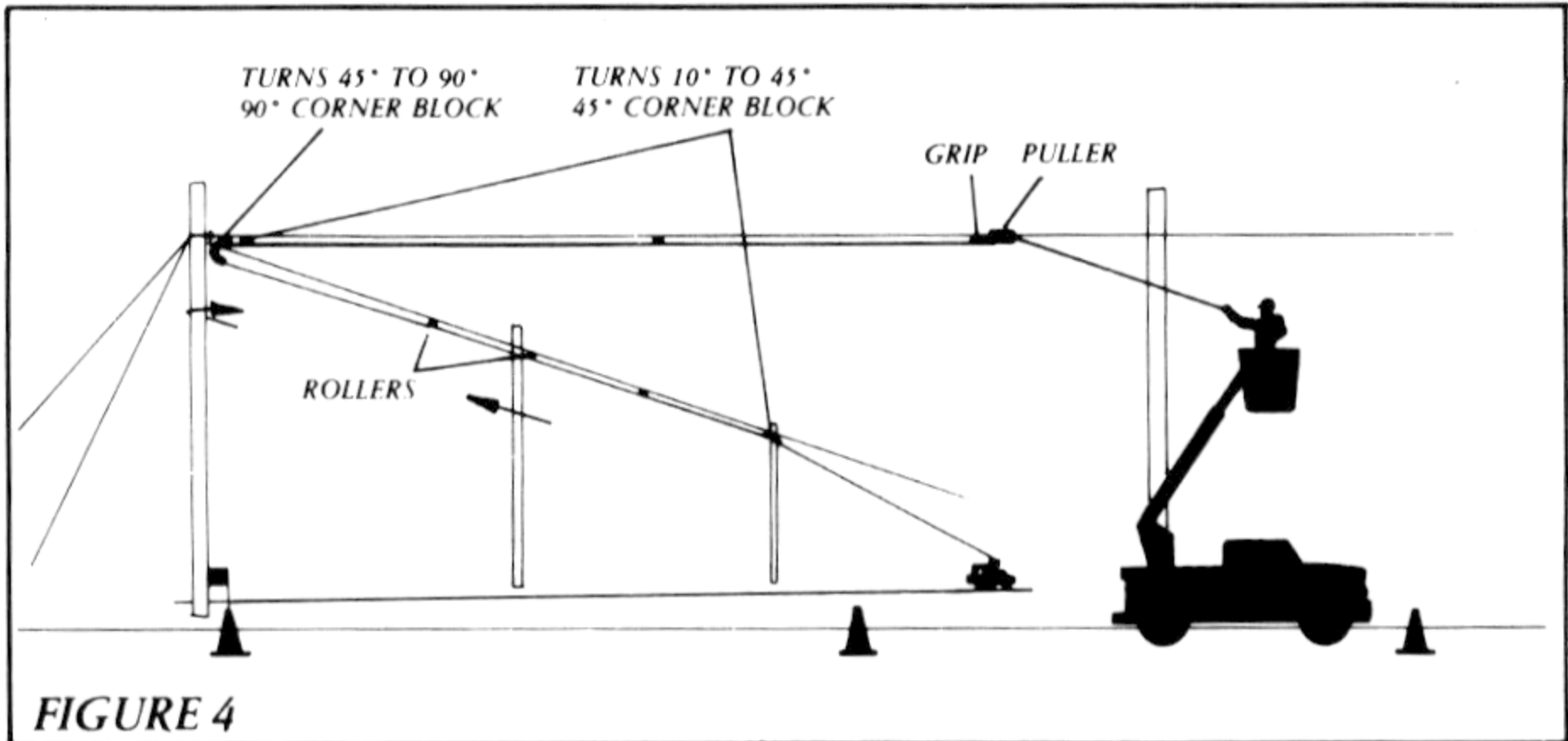
The strand chute and pole bracket are installed on the first pole and the 45° cable block secured to the bracket. At the same time, the cable puller, if used, is installed onto the strand. The rotating eye pulling grips are then placed on the ends of all of the reels of cable to be pulled into place. The pulling grips are attached to the swivel eyes on the cable puller after the cables have been properly positioned across the rollers of the 45° corner block used as the stationary cable chute.

If conditions dictate that the cable can be pulled into place span by span with a pulling line attached to the cable or cable puller, the pulling line should be attached and the cable pulled into place, span by span. Adequate cable blocks (rollers) are placed on the strand at approximately 50 foot intervals with a block-lifting tool. After the cable has been pulled past each cable block location by approximately 50 feet, the tension on the cable is relaxed and the cable(s) are lifted onto the cable block (rollers) with the cable lifter. See Figure 3.



This same procedure is followed span by span until the cable reaches the point where the lashing process is to commence.

As the cable is pulled in at locations where the cable makes turns 10° to 45° , a 45° cable block assembly is installed on the strand or pole. The 90° cable block is utilized at all locations greater than 45° and up to 90° . The cable should not be pulled around more than one 90° turn. See Figure 4.



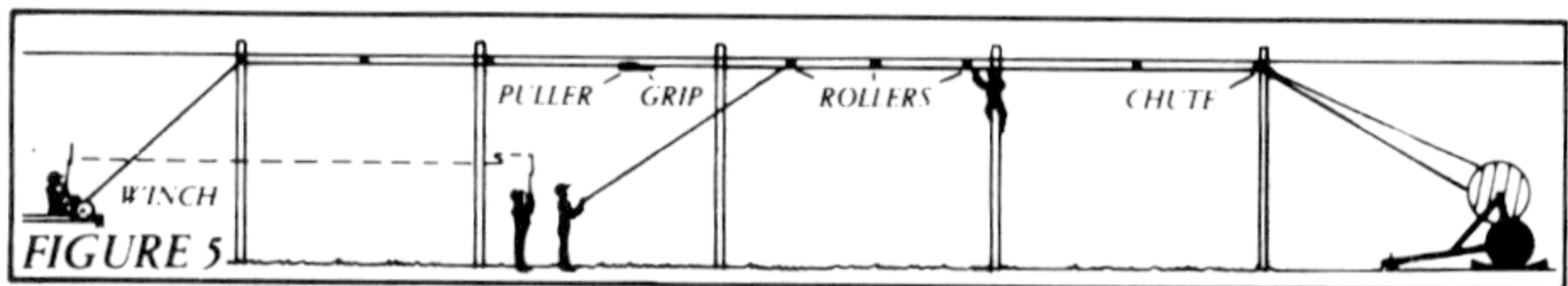
INSTALLATION PROCEDURES - BACK PULL - WINCH - LASHING CABLE

If conditions dictate that the length of the route or number of cables being pulled requires the use of the winch, the following procedures are followed:

All cable blocks (rollers) are placed on the strand with the cable block lifting tool, the entire length of the cable run. All 45° and 90° cable blocks (rollers) are also installed. From the anticipated end of the run, the winch is set up and adjusted toward the cable run. The winch cable is then strung along the cable run and placed over all of the cable blocks (rollers) at all non-stress locations. The winch line should run across steel winch line blocks (rollers) at all corners and other points of stress to avoid damage to the rubber or plastic rollers that are used in the cable roller blocks.

After the winch line has been connected to the cable or cable puller, the winch operator tensions the winch line and the cable reel brake is adjusted so that the pulling tension on the cable(s) does not exceed recommended pulling tension, according to individual cable specifications. A dynamometer should be utilized on all long cable pulls or where the tension on the cable might exceed the specifications.

The cable should be pulled into place with the winch span by span to the point where the lashing will commence. When using the cable puller, the cable rollers are removed and replaced as the puller passes. See Figure 5.

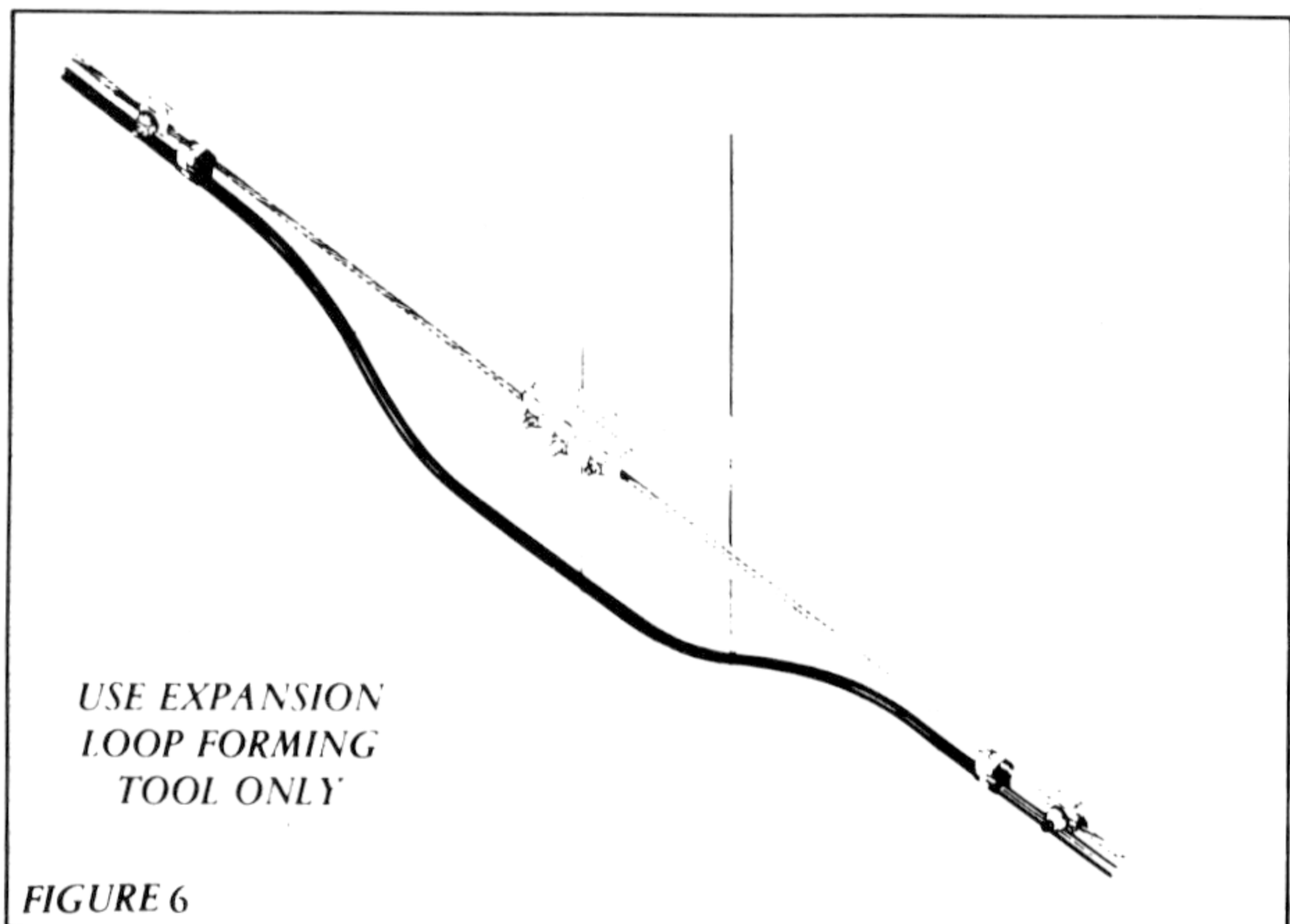


There should be adequate personnel in communication with the winch operator to watch the cable as it is being pulled into place. After the cable has been pulled into place, the lashing machine, cable block pushers and cable positioner, are placed on the strand and the cable properly positioned through them. The cable(s) is then lashed span by span back to the reel trailer location. As each span is lashed, excess cable slack is re-rolled onto the reels and all cable blocks (rollers) are removed. The cable at each of the pole locations is attached, as shown in Figures L-1 through L-10.

INSTALLATION PROCEDURES - EXPANSION LOOP

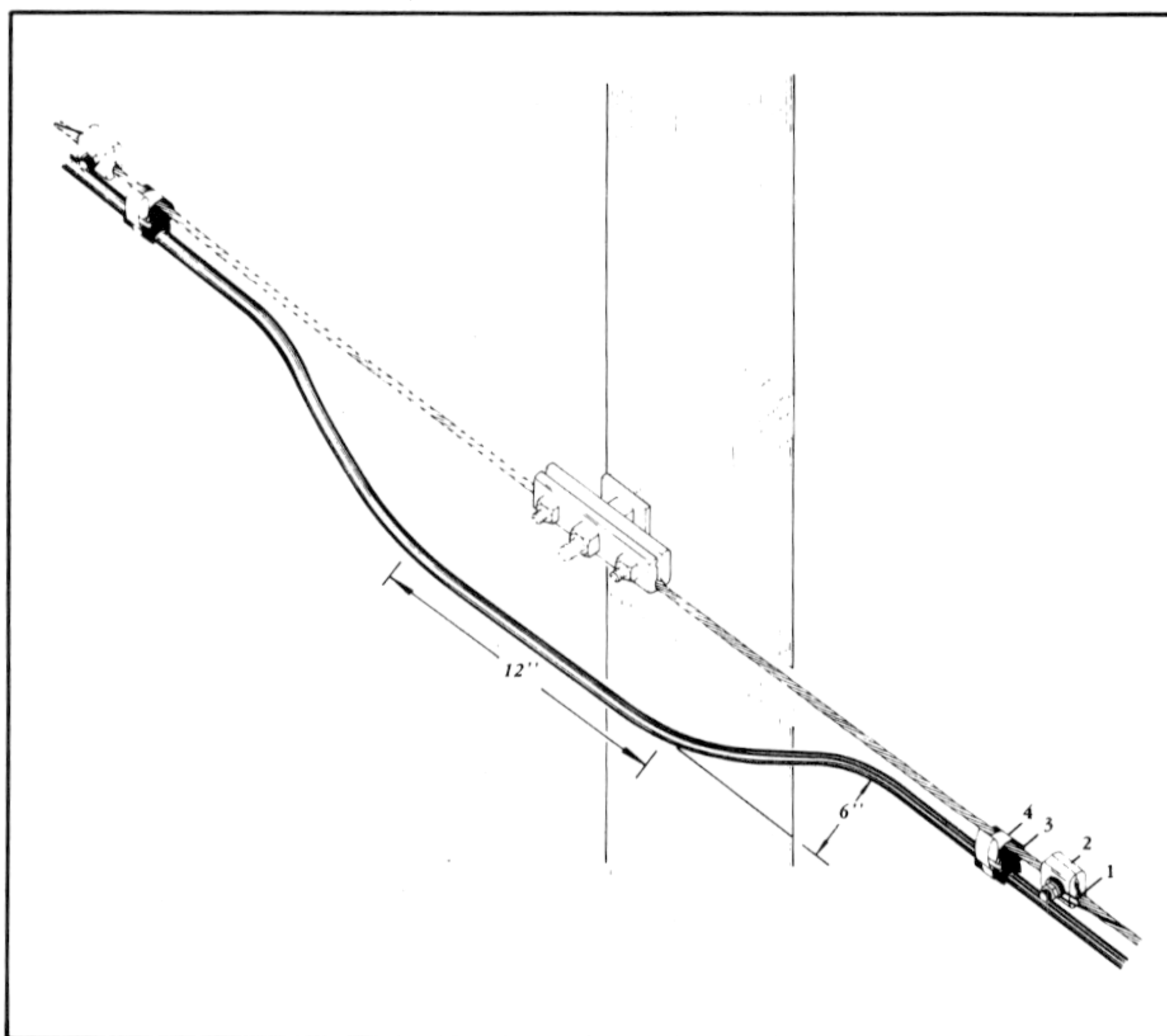
To allow for maximum temperature extremes, expansion loops are placed at each pole and at the input and output of all equipment. For locations where maximum temperature variations are not anticipated, users may modify the number and placement of loops based on their evaluations of installations in similar locations and under similar conditions.

In all cases, expansion loops should always be formed with a tool designed for the purpose and never by hand. See Figure 6.



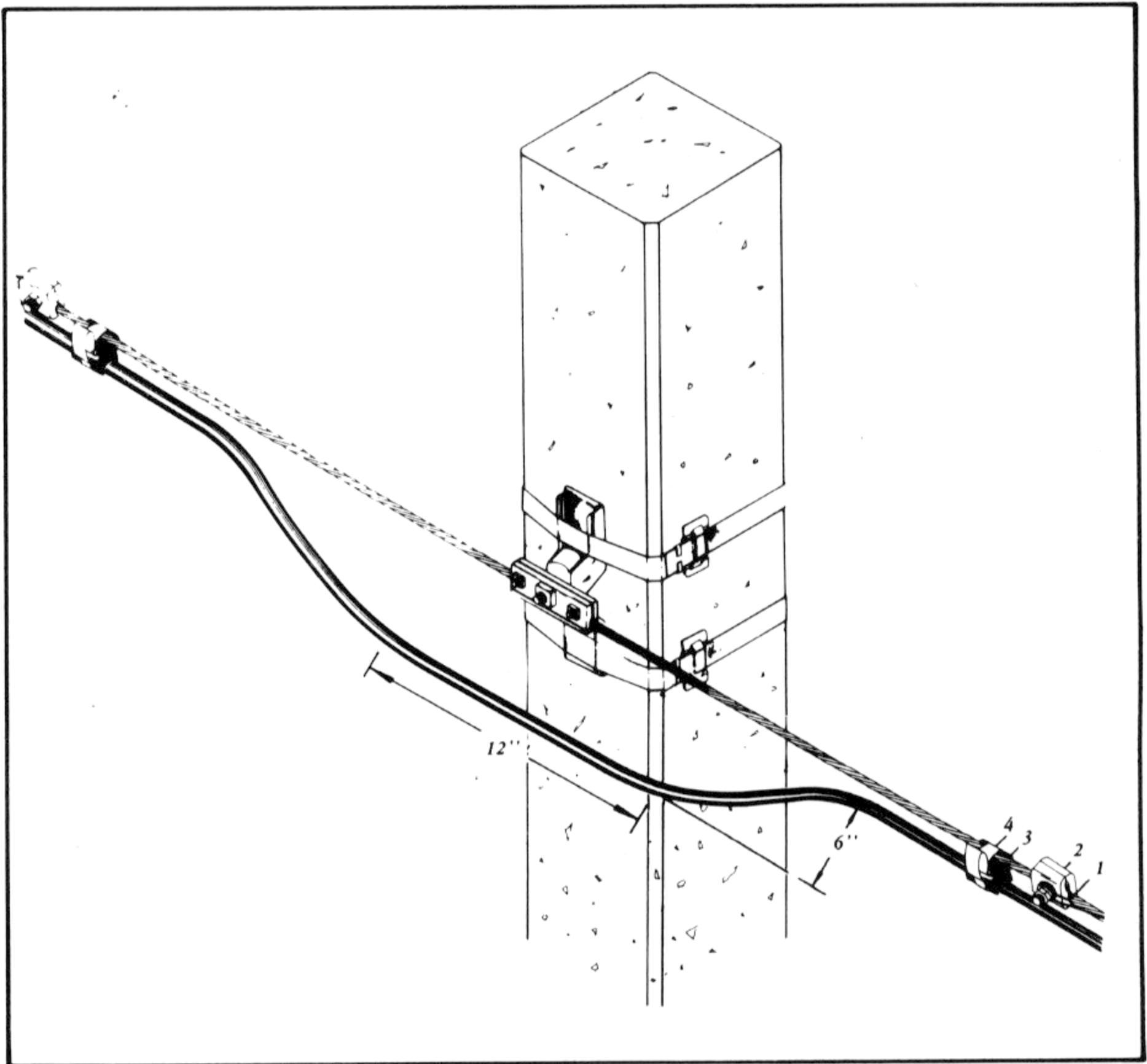
CABLE HANDLING AND INSTALLATION PROCEDURES
LASHED CABLE
POLE FRAMING ILLUSTRATIONS
EXPANSION LOOP

	Page
Figure L-1 Cable Placing - Straight Line	IL-73
Figure L-2 Cable Placing - Straight Line - Steel or Concrete Pole	IL-74
Figure L-3 Cable Placing - Angle Pole	IL-75
Figure L-4 Cable Placing - Straight Line Pole Cross-Over	IL-76
Figure L-5 Cable Placing - Mid-Span Cross-Over	IL-77
Figure L-6 Cable Placing - False Dead-End	IL-78
Figure L-7 Cable Placing - Line Pole Dead-End Combination No. 1	IL-79
Figure L-8 Cable Placing - Line Pole Dead-End Combination No. 2	IL-80
Figure L-9 Cable Placing - Dead-End	IL-83
Figure L-10 Cable Placing - Double Dead-End	IL-82



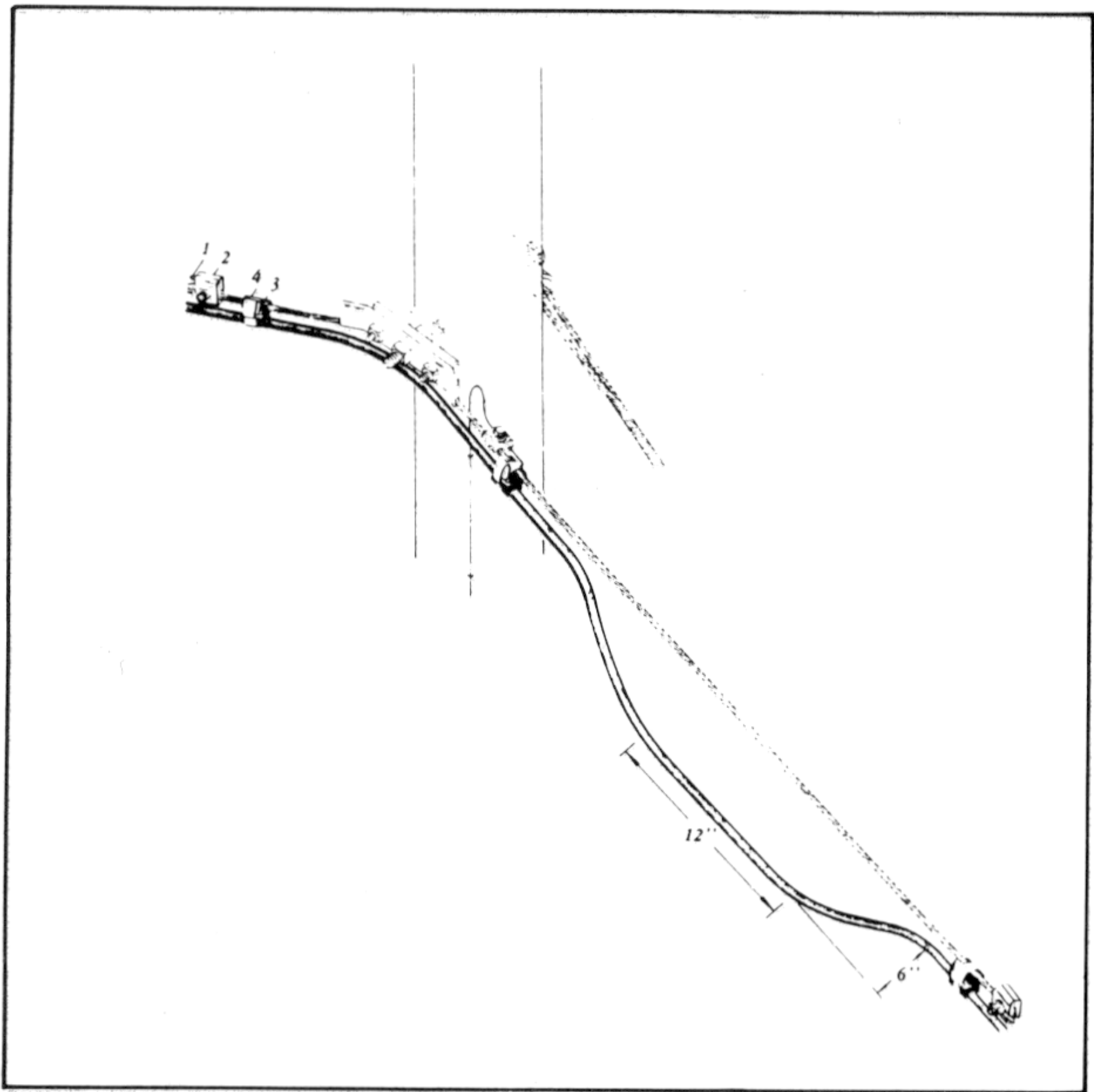
<i>Item</i>	<i>Description</i>
1	0.045 Stainless Steel Lashing Wire
2	Lashing Wire Clamp
3	Cable Spacer
4	Cable Support Strap

FIGURE L-1 CABLE PLACING - STRAIGHT LINE



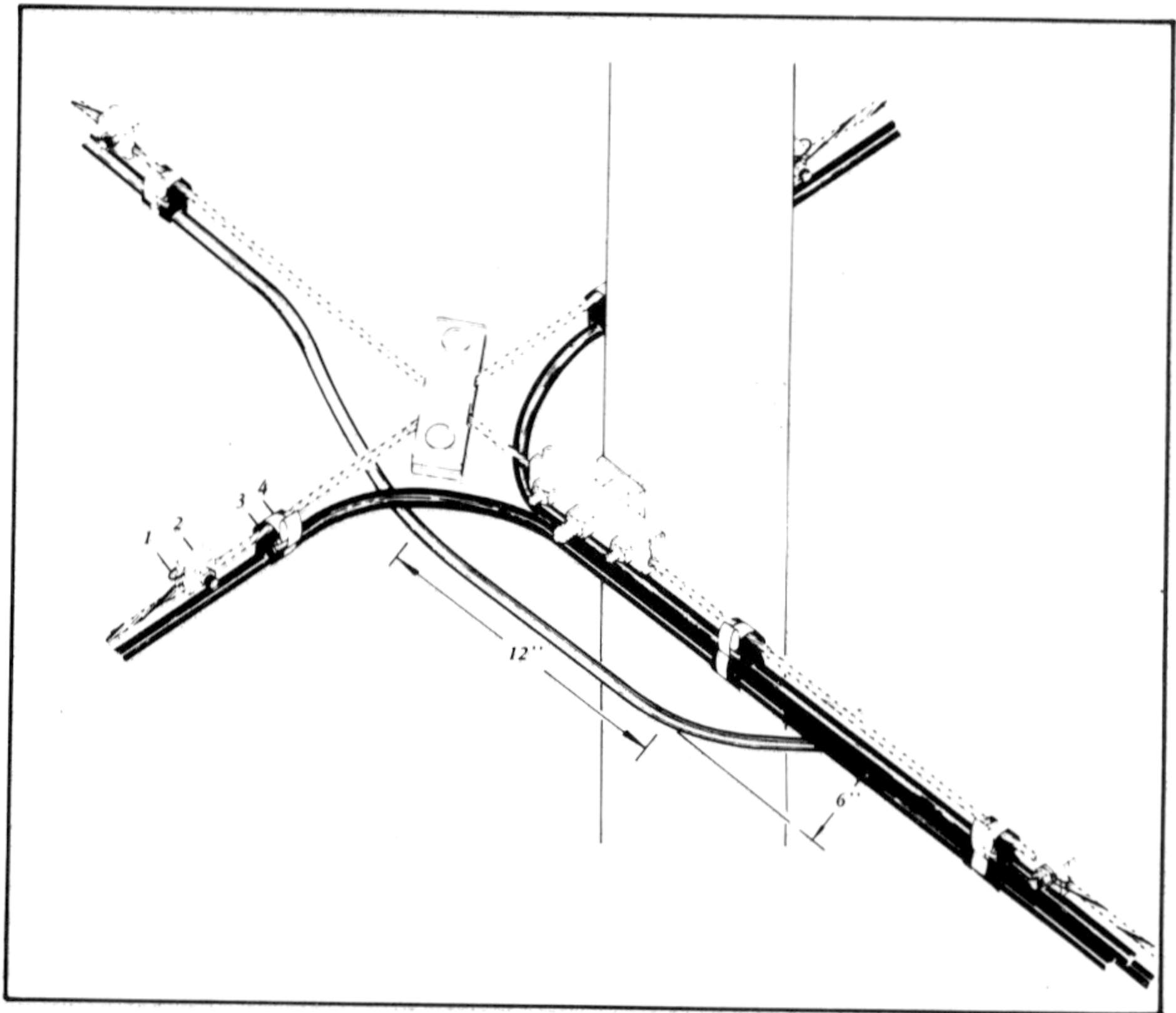
<i>Item</i>	<i>Description</i>
1	0.045 Stainless Steel Lashing Wire
2	Lashing Wire Clamp
3	Cable Spacer
4	Cable Support Strap

FIGURE L-2 **CABLE PLACING - STRAIGHT LINE**
-STEEL OR CONCRETE POLE

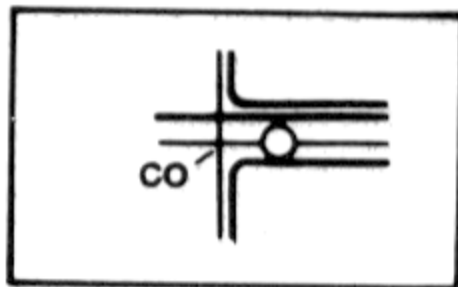


<i>Item</i>	<i>Description</i>
1	0.045 Stainless Steel Lashing Wire
2	Lashing Wire Clamp
3	Cable Spacer
4	Cable Support Strap

FIGURE L-3 CABLE PLACING - ANGLE POLE

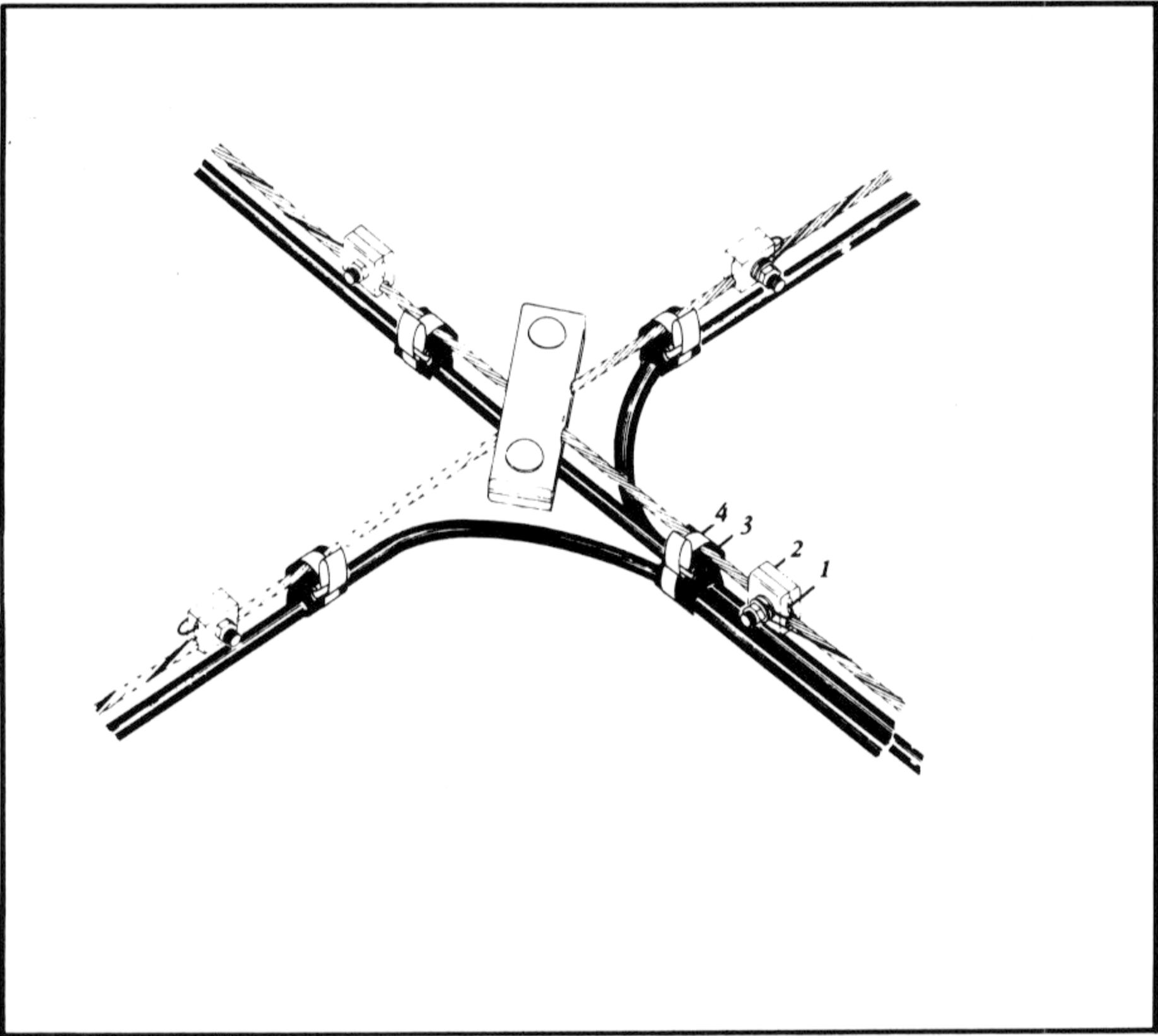


Map Legend

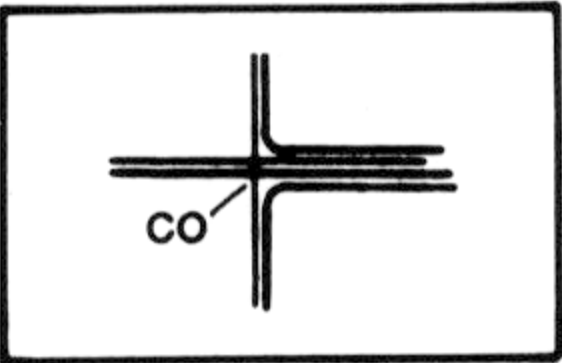


Item	Description
1	0.045 Stainless Steel Lashing Wire
2	Lashing Wire Clamp
3	Cable Spacer
4	Cable Support Strap

FIGURE L-4 CABLE PLACING - STRAIGHT LINE
POLE CROSS-OVER

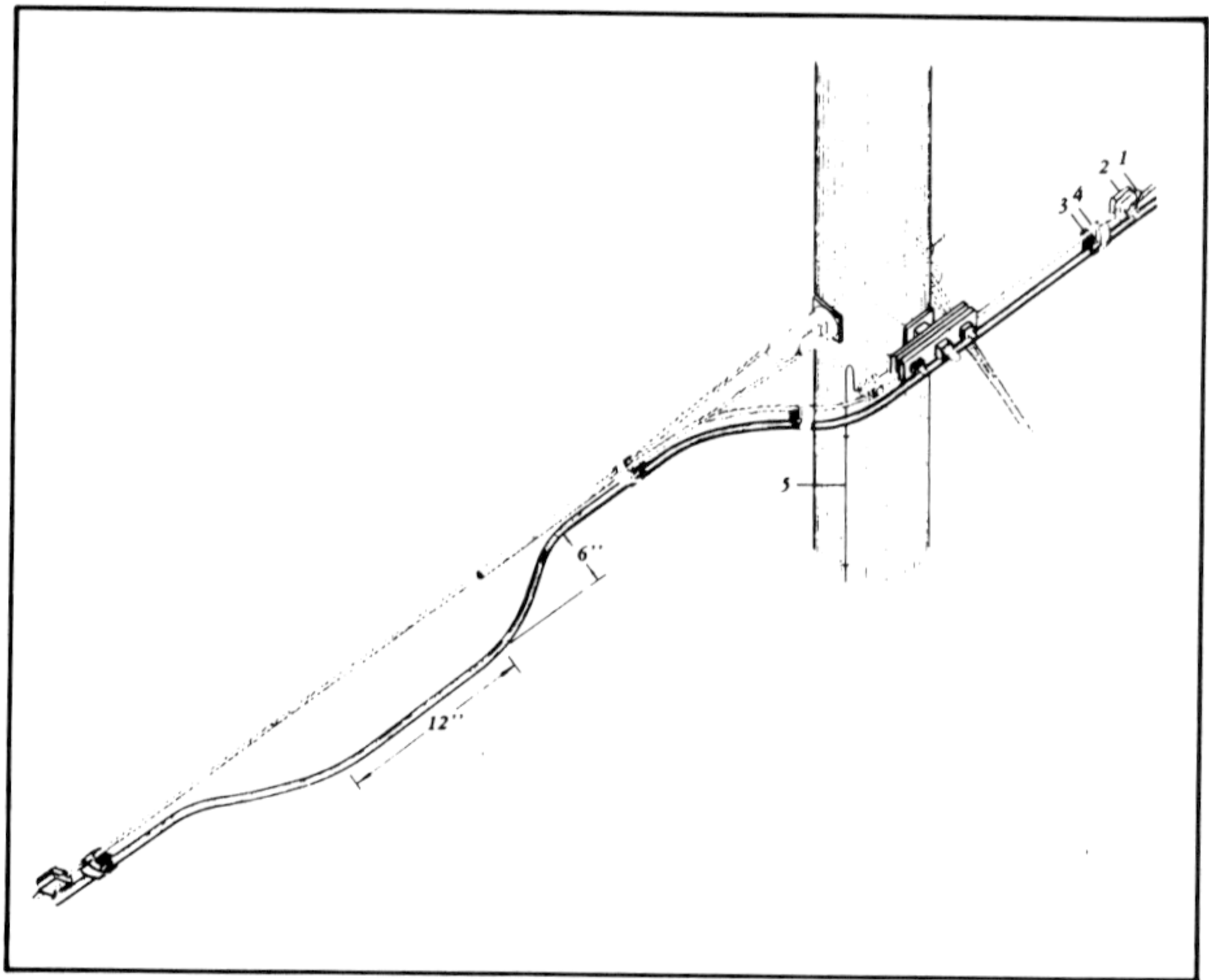


Map Legend



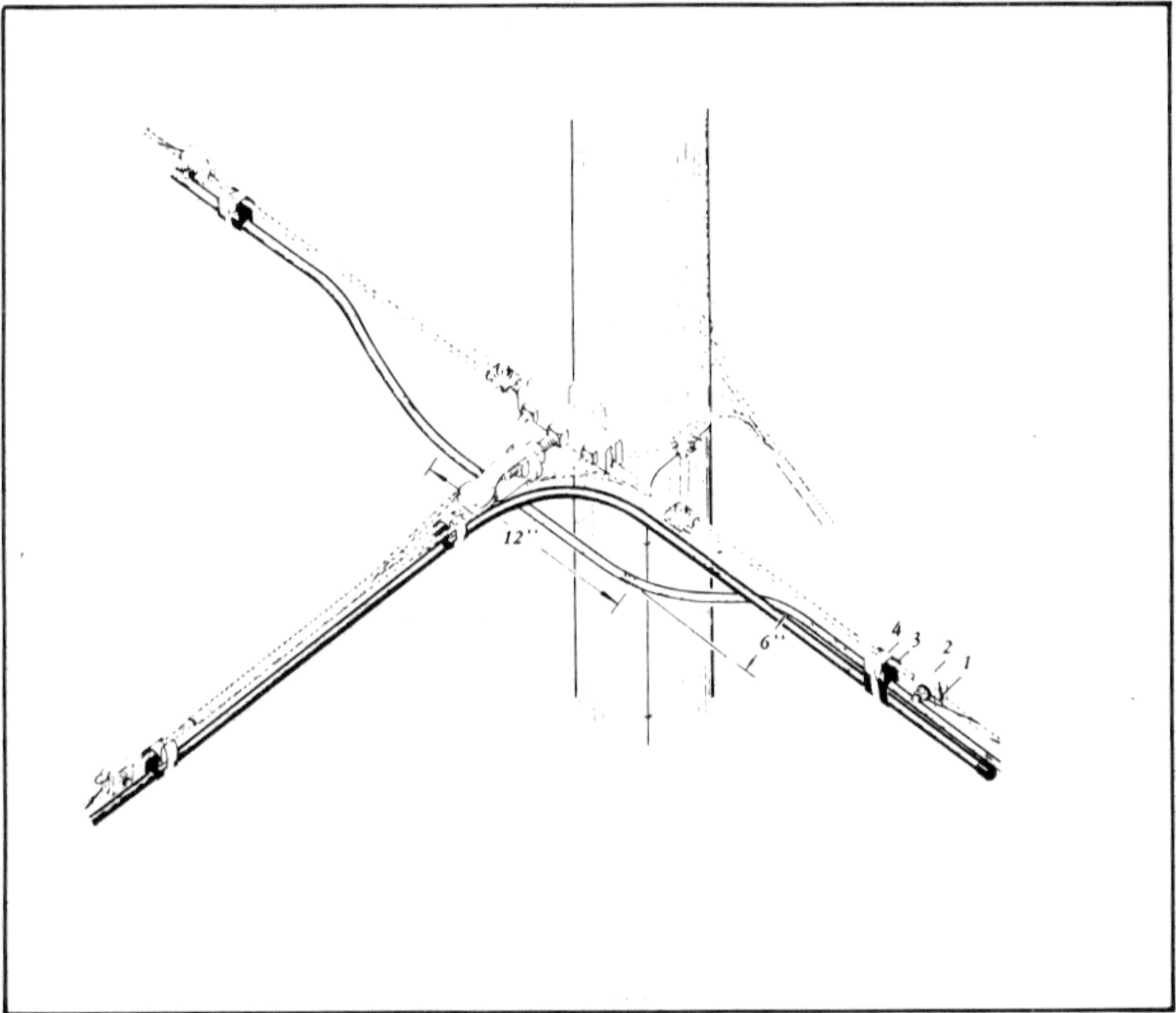
<i>Item</i>	<i>Description</i>
1	0.045 Stainless Steel Lashing Wire
2	Lashing Wire Clamp
3	Cable Spacer
4	Cable Support Strap

FIGURE L-5 CABLE PLACING - MID-SPAN CROSSOVER



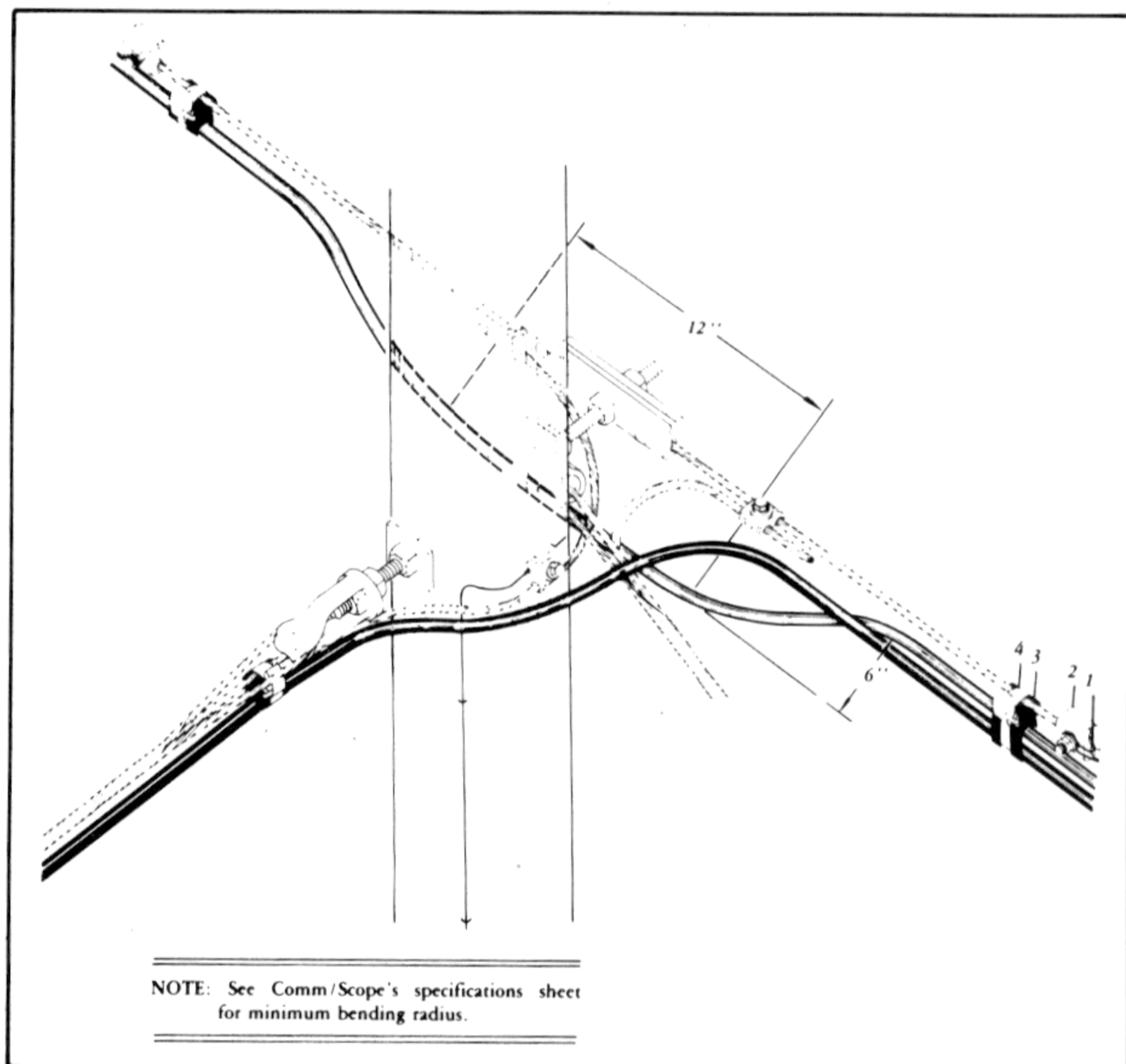
<i>Item</i>	<i>Description</i>
1	0.045 Stainless Steel Lashing Wire
2	Lashing Wire Clamp
3	Cable Spacer
4	Cable Support Strap
5	Ground Wire

FIGURE L-6 CABLE PLACING - FALSE DEAD-END



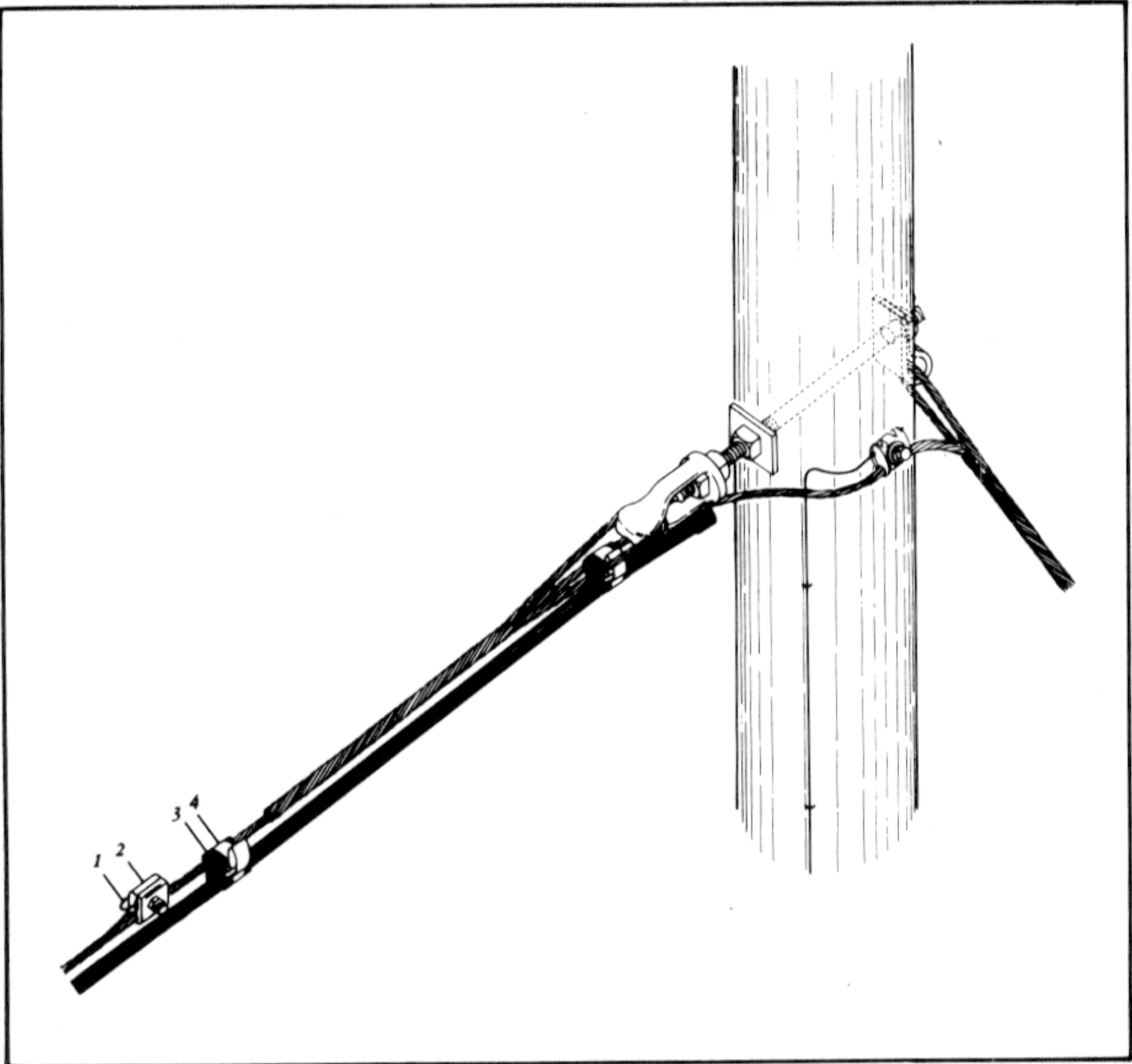
<i>Item</i>	<i>Description</i>
1	0.045 Stainless Steel Lashing Wire
2	Lashing Wire Clamp
3	Cable Spacer
4	Cable Support Strap

FIGURE L-7 **CABLE PLACING - LINE POLE DEAD-
END COMBINATION No. 1**

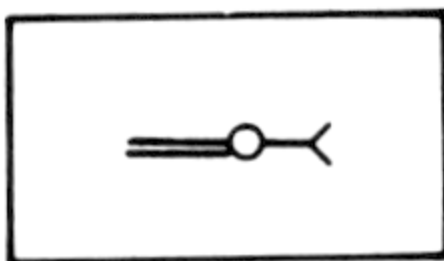


Item	Description
1	0.045 Stainless Steel Lashing Wire
2	Lashing Wire Clamp
3	Cable Spacer
4	Cable Support Strap

FIGURE L-8 CABLE PLACING - LINE POLE DEAD-
END COMBINATION No. 2

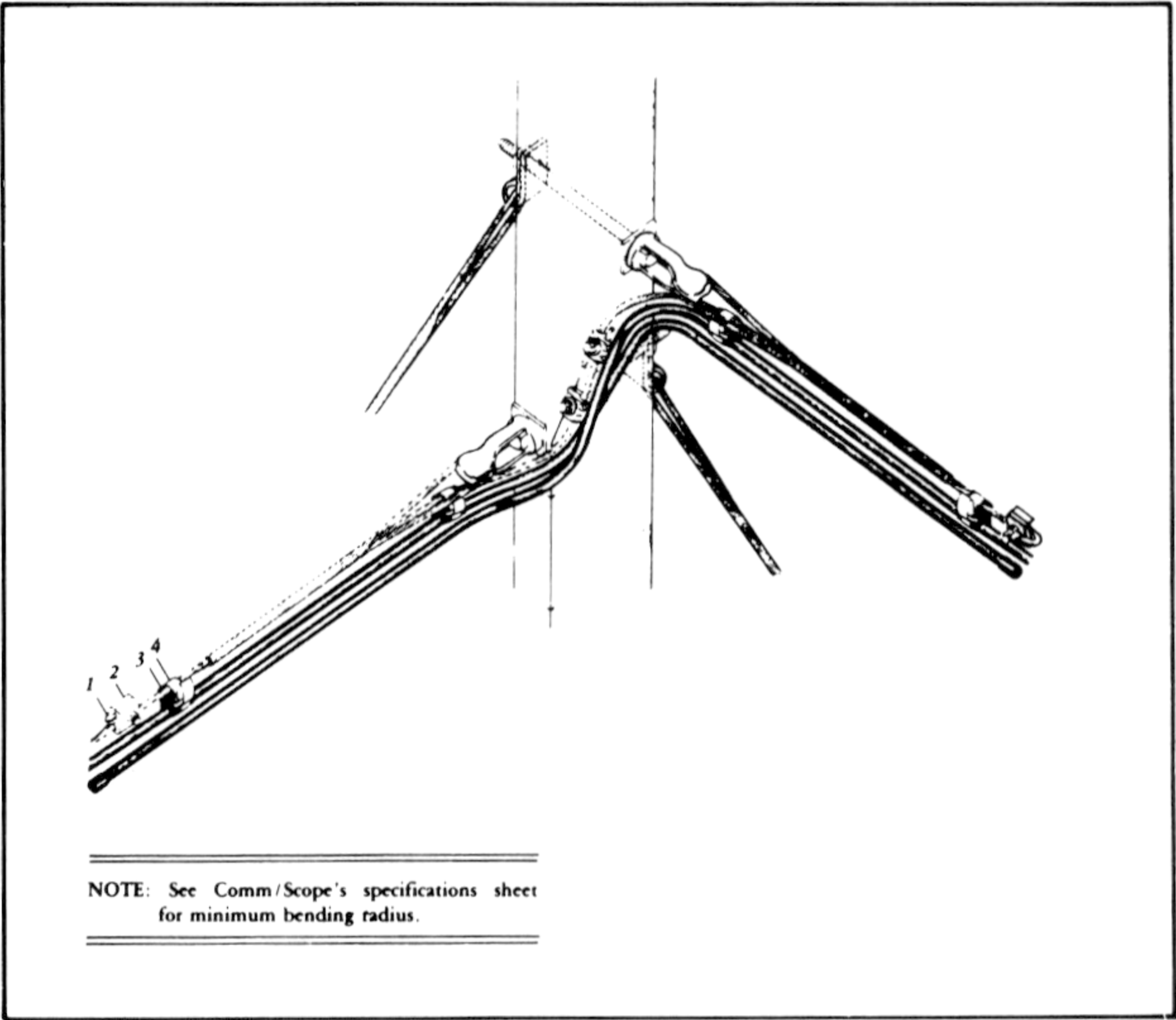


Map Legend

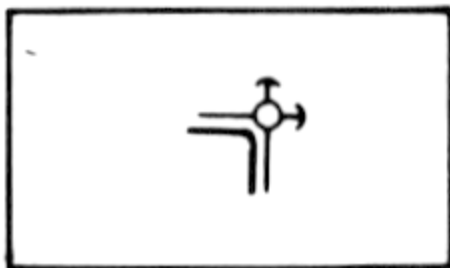


<i>Item</i>	<i>Description</i>
1	0.045 Stainless Steel Lashing Wire
2	Lashing Wire Clamp
3	Cable Spacer
4	Cable Support Strap

FIGURE L-9 **CABLE PLACING - DEAD-END**



Map Legend



<i>Item</i>	<i>Description</i>
1	0.045 Stainless Steel Lashing Wire
2	Lashing Wire Clamp
3	Cable Spacer
4	Cable Support Strap

FIGURE L-10 CABLE PLACING - DOUBLE DEAD-END

Cable Handling and Installation Procedures

Underground Cable

UNDERGROUND CABLE INSTALLATION PROCEDURES

General

The installation of underground type coaxial cables should be undertaken with caution because of the many hazards that exist can damage the cable both during and after installation. The largest expense involved in underground is the opening and closing of the trench. It is quite often more economical to replace a portion of cable damaged in the installation process than to spend excessive amounts of money trying to protect the cable which is the smallest cost involved. Therefore, this section will recommend installation procedures designed to reduce the overall cost of underground construction, rather than provide ultimate protection to the cable. When using aluminum jacketed flooded cable, loss of an estimated four hundred feet (400') per mile may be expected in addition to the normal reel end losses. All of these installation procedures assume normal soil conditions.

Notifications

Prior to commencement of construction in any underground area, all persons and companies having buried facilities shall be notified for assistance in locating their respective facilities. After notification, these facilities are found by locators and small flags are placed over their locations.

Precautions

All trenching and plowing shall be in accordance with local requirements and permits. All trenching, boring and plowing should be confined to that which can be completed in not more than two (2) working days. All open trenches and bore pits shall have proper barricades and lights and/or covers at all times where work is in process.

There are many different conditions which prevail when placing underground cable. The sets of circumstances covered by this section will deal with the installation of underground cable in easements, along streets in developed areas and across open areas.

Tools and Cable Reels

After selection of proper equipment according to specifications and guide lines established in this manual, and after properly loading the cable to be installed, proceed to the selected installation site and begin construction.

INSTALLATION PROCEDURES - EASEMENT ROUTES - UNDERGROUND CABLE

At the installation site where the cable is to be placed along backyard easements or area inaccessible by vehicles, the following procedures are good installation techniques. See Illustrations UG-1 thru UG-6.

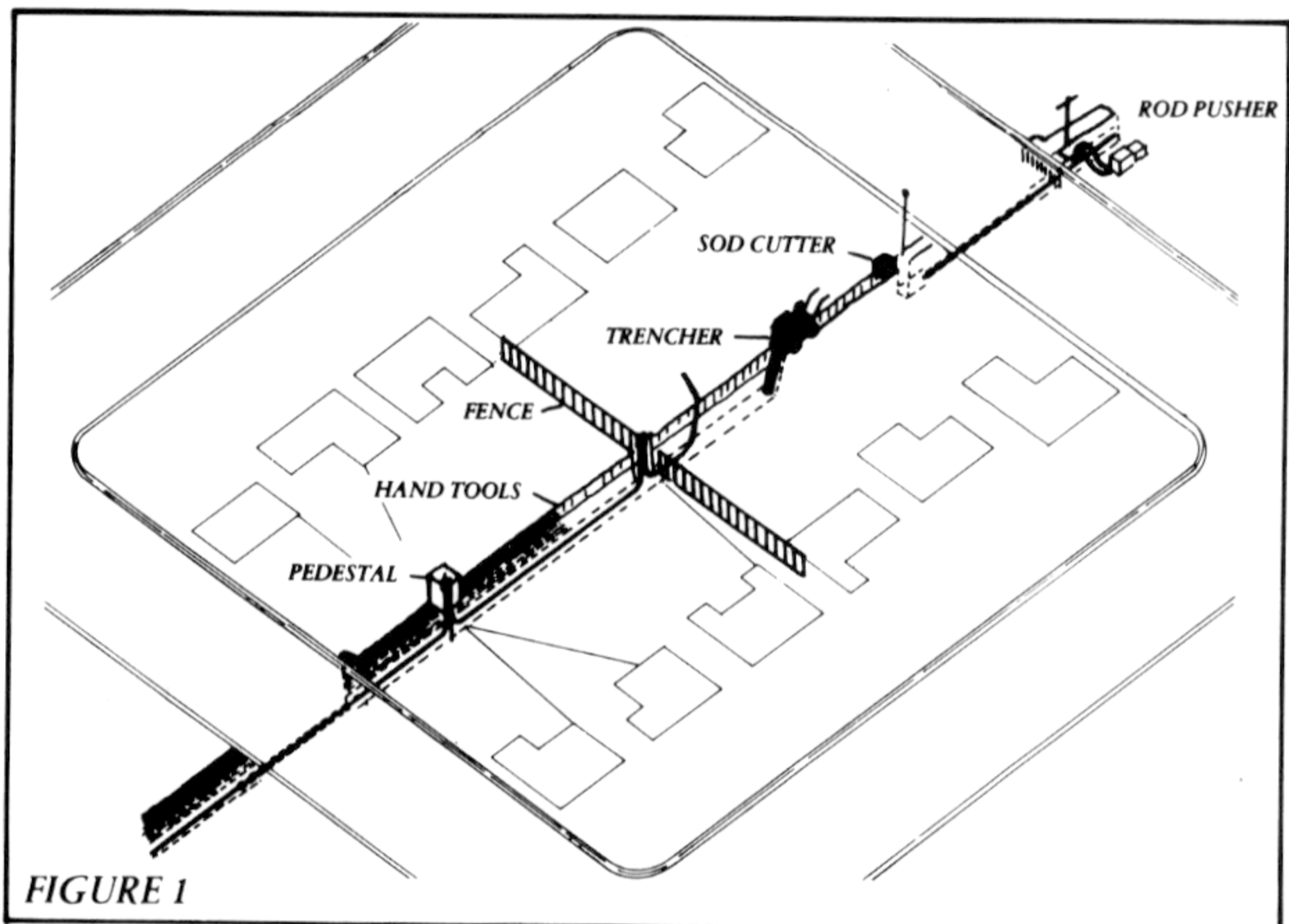
The reel covers are removed and the inside reel flanges are carefully inspected to insure that the surface is smooth and free from nails or other imperfections which will damage the cable while unreeling.

Trenching - Single Cable Routes

The sod removal and small trenching machines are unloaded and taken into the first backyard where the first cable pedestal is to be placed.

First, the sod cutter cuts a strip of sod along the easement between the houses. Five foot (5') lengths of the cut sod are removed from the trench line the entire length of the yard. The trencher then digs as narrow a trench as possible to a depth specified by the installation specifications applicable to the project. See the Illustrations UG-1 thru UG-6 in the back of this section.

If a fence is encountered on the side of the yard, the trencher or hand tools are used to cut the trench under the fence for access to the adjacent yard. This same process is followed until the trench reaches the next pedestal location. See Figure 1.

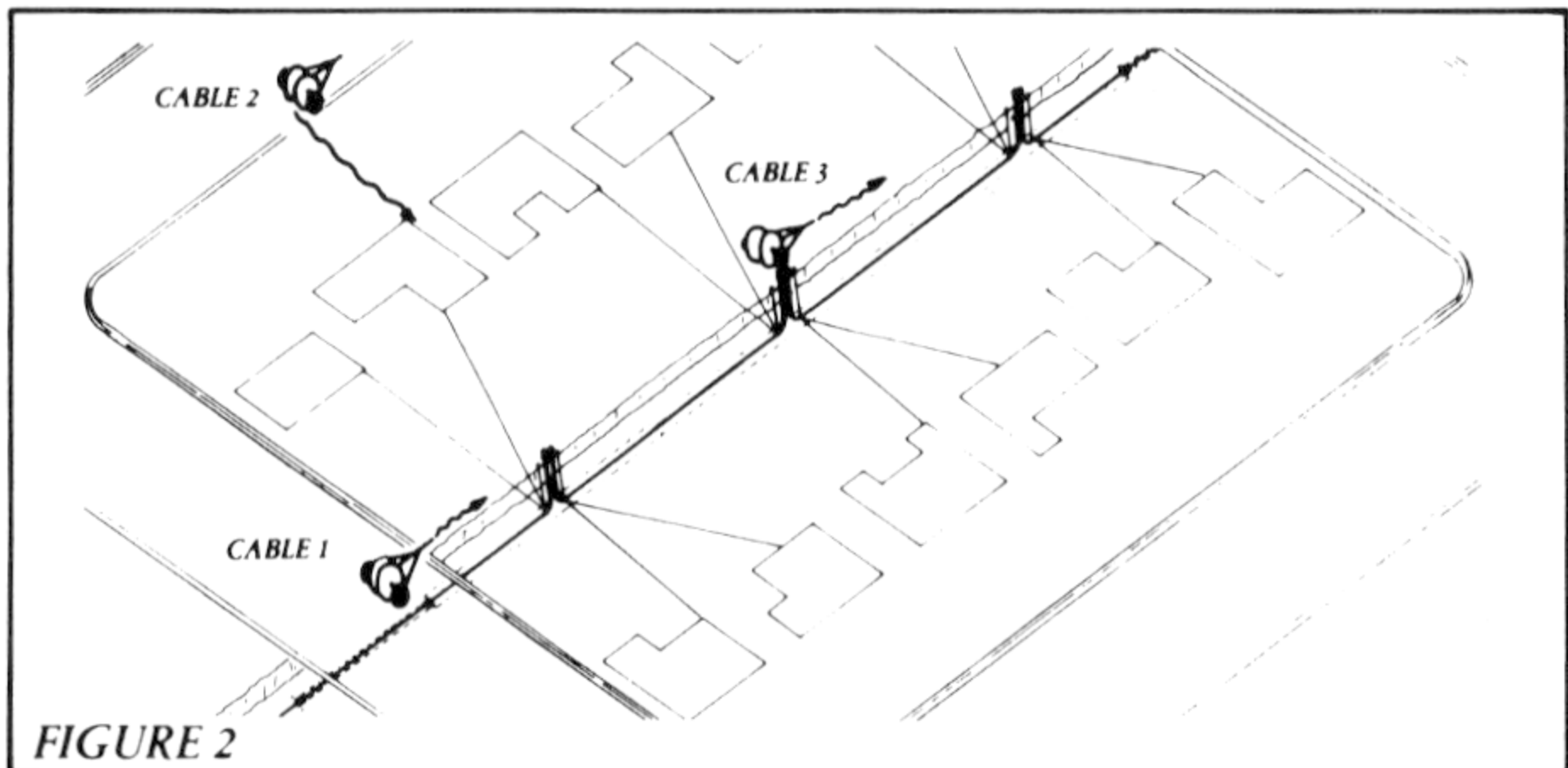


There are three ways to place the cable between the pedestals when placing cable in easements.

1. Position the reel trailer on the street at the end of the easement. Then pull the cable along the easement route feeding it into the open trench and under all fences, through all bores and other obstacles.

2. Position the reel trailer on the street in front of the house, and measure the distance between the pedestal locations. Then, unreel, measure and cut off the proper amount of the cable to be used. Pull it between the houses and feed it into the open trench and under all fences through all bores and other obstacles.

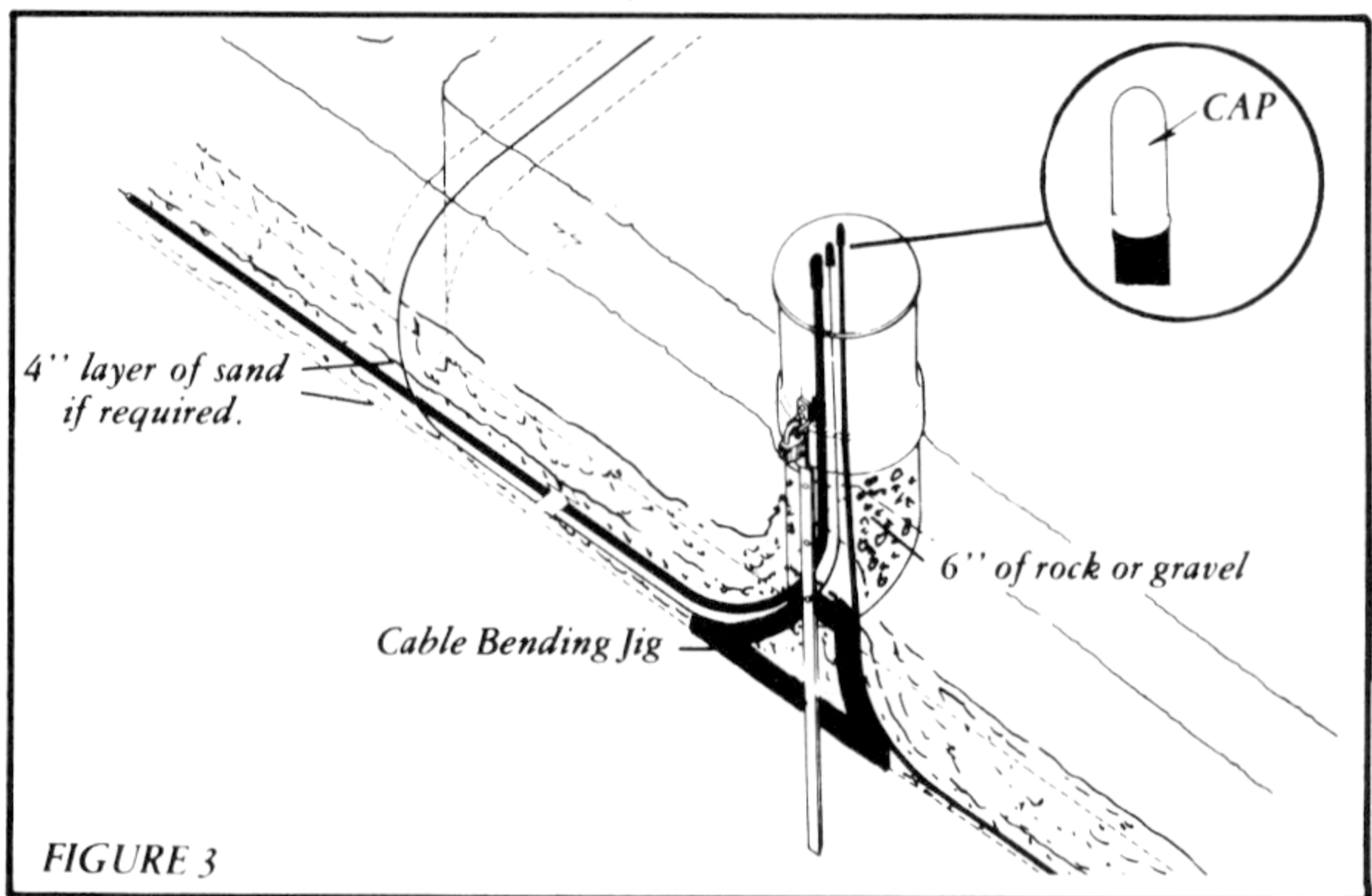
3. Unload the reel handlers from the transport vehicle and roll them into the backyards to the first pedestal location. Then, position the reel so that the cable will feed into the open trench toward the next pedestal location. Unreel the cable into the trench and under all fences, through all bores and other obstacles. See Figure 2.



Prior to cutting the cable, be sure there is adequate cable coming out of the trench to reach the top of the pedestal. A Cable Bending Jig should be used to position the cable. (See Figure 3). When the cable is placed into the open trench under all fences, through all bores, and under all other obstacles between the pedestals, following one of the methods given above, the trench is backfilled with the material that was removed. If rock or other materials are encountered while trenching that may damage the cable when it is used to backfill the trench, a four inch (4") layer of sand is put into the trench around the cable as a protection pad prior to backfilling. See Figure 3.

The trench line is then tamped to prevent settlement and the five foot (5') length of sod previously removed are replaced and tamped. The sod should be provided with adequate water and care until the roots have again become permanent. The six inch (6") portion of each pedestal that is below ground level is filled with rock or gravel to provide proper drainage. This procedure continues backyard to backyard for the entire length of the easement route.

At all pedestal locations where the cable ends are cut to accommodate equipment, cable protection caps are placed on the cable ends to protect the cable from the elements. See Figure 3.



INSTALLATION PROCEDURES - UNDERGROUND

Plowing - Single Cable Runs

Machine or hand trench the pedestal site and a three foot (3') plow starter trench to the proper depth along the cable route. Next, machine or hand trench the next pedestal site in the cable run along with a plow blade starter trench three feet (3') long on each side of the pedestal site. If a fence or other obstacle is encountered between these two pedestal sites, dig a trench three foot (3') long plus the length of the plow machine on one side and under the fence or obstacle for stopping the plow and a three foot (3') starting trench on the opposite side of the fence or obstacle.

The cable is unreeled according to one of the three cable unreeling procedures described in the Trenching Single Cable instructions given

on page UG-85 and UG-86 of this section. The cable is placed along the plow route under all obstacles between the pedestals. The vibrating plow is positioned facing the plow route and the blade is lowered into the three (3') foot starting trench. The cable is fed through the cable chute on the vibrating plow blade into the open trench.

The vibrating plow machine then plows the cable into the ground to the next, open receiving trench in the plot route. The cable is removed from the plow blade chute and the vibrating plow machine is relocated to the next cable plowing starting trench in the route.

The cable is fed into the pedestal location and all of the trenches are backfilled and the plow route is tamped and watered.

This procedure continues pedestal to pedestal to the end plow route.

INSTALLATION PROCEDURES - UNDERGROUND

Boring

Where driveways, sidewalks and other short bores are encountered along the route, boring pits are dug on each side of the areas and a rotating boring machine is used to bore or compact holes under these areas with adequate diameter to accommodate the cable or conduit to be used. See Figure 4.

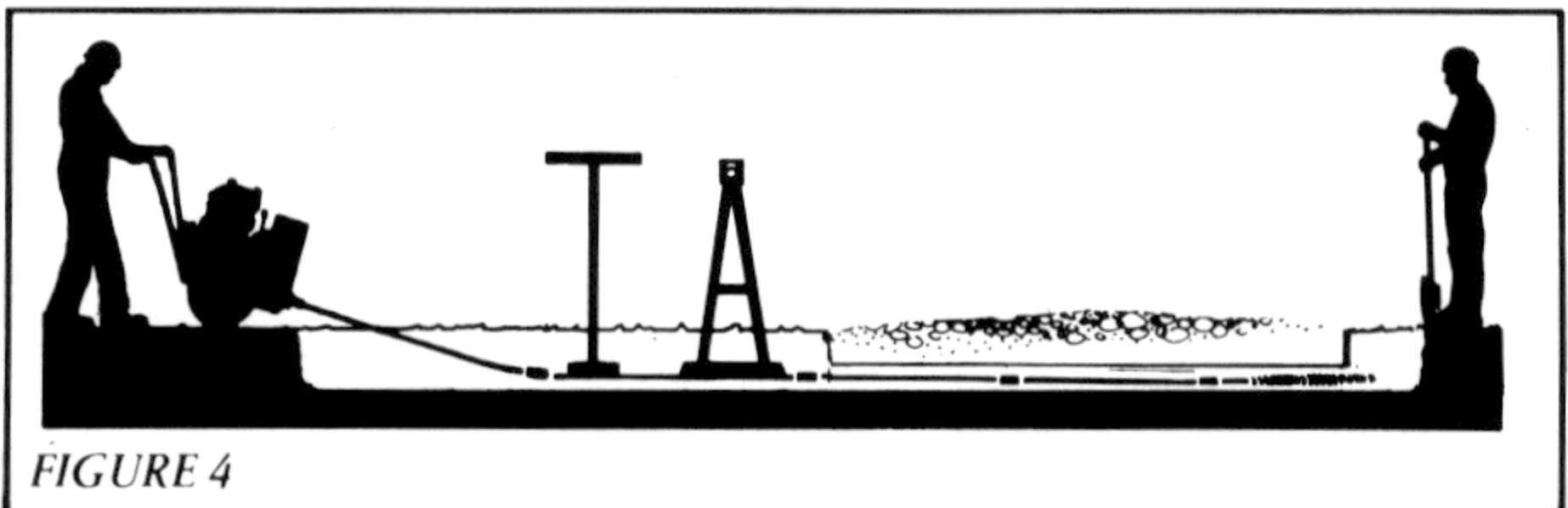


FIGURE 4

Follow These Steps When Boring:

1. When using rotating boring machines, connect together adequate boring steel or rod to reach through the bore. Attach the bit to be used onto the boring steel and the steel to the rotation machine.

2. Place the bit and boring steel into the boring pit. Place a target at the desired receiving pit on the opposite side of the area to be bored. Place the guide on the boring steel and align the steel so the guide is pointing at the target. Then level the first section of steel and start the machine. As the bit pulls itself through the bore, keep the guide on the target and the boring steel level.

3. When the length of boring steel required to reach through the bore has been used, stop the machine. Many times the boring bit hits an obstacle and is diverted away from the target site. Therefore, take a

pipe locator and locate the boring bit near the target site. Then dig a receiving pit and locate the bit.

4. Replace the boring bit with a reamer/swivel eye if a larger hole is required, or a swivel eye attachment if the hole size is adequate.

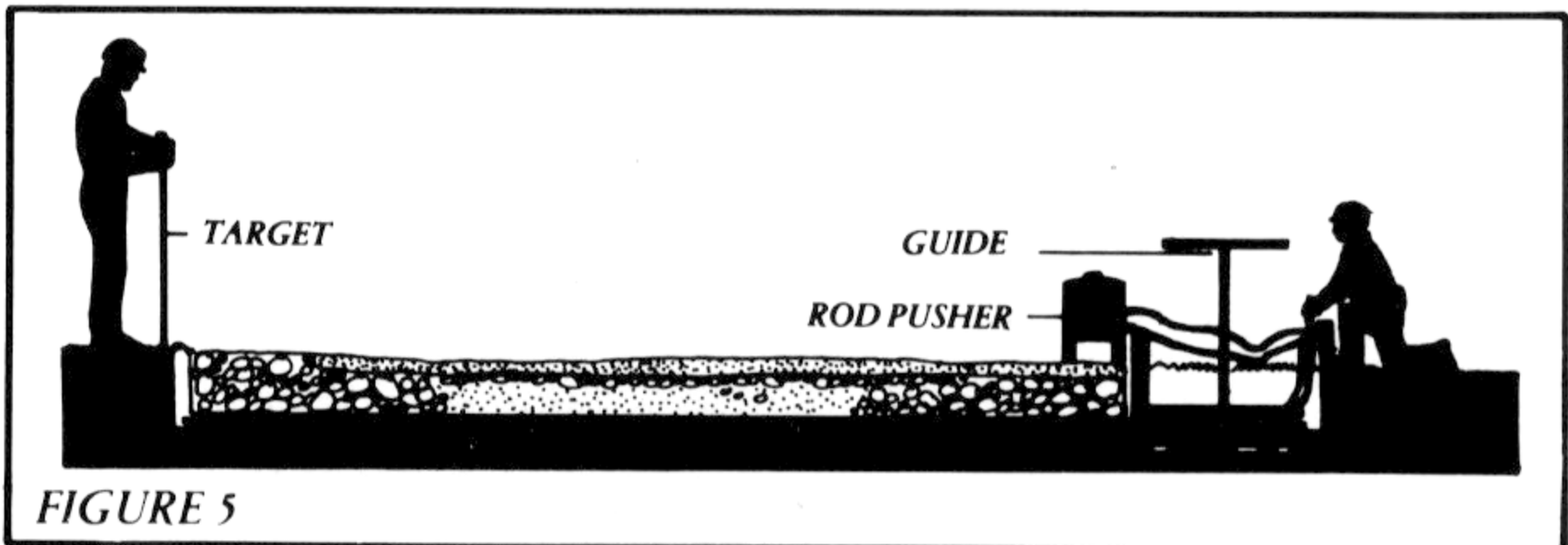
5. Attach a rotating eye grip to the end of the cable, conduit or pull line and the eye of the grip to the swivel eye on the boring steel. Then, start the machine and pull the steel back through the bore.

6. When the swivel eye and rotating eye grip are pulled back to the boring pit, remove them and pull the balance of the cable, conduit or pull line required through the bore.

Each bore is completed according to instructions given above.

Boring Streets

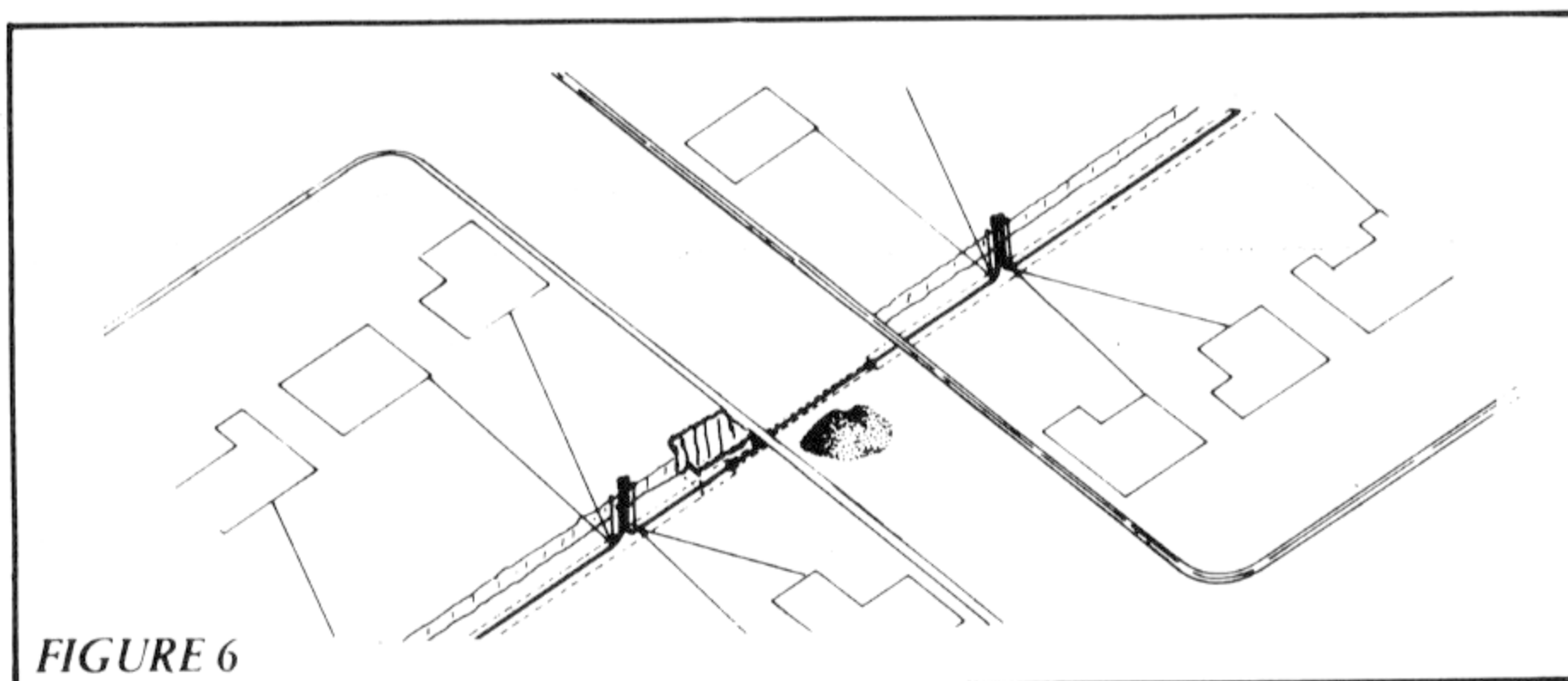
Where streets of average width are encountered along the route a rod pusher is used instead of a rotating boring machine. See Figure 5.



Steps 1 through 6 under rotating boring machines are taken when using a rod pusher except the rod sections are put together and leveled as they are pushed through the bore and taken apart as they are pulled back.

Boring the sidewalks on each side of the street is usually a separate boring operation, however, the same boring procedures apply.

The trench is then cut along the easement to line up with the bore. The cable is placed in the trench on each side of the bore under all fences and obstacles to the pedestal location, and the bore pits and trenches are backfilled with the materials which were removed using four inches (4") of sand, if required.



When backfilling bore pits, an optional method is to backfill all but the top one foot (1') with sand to prevent settlement, and then the last foot with the material which was removed. All material is tamped to prevent settlement and all sod is replaced, tamped and watered. When sand is used, the balance of the material dug from the bore pits is loaded and hauled from the site.

Each street encountered in the run is completed according to instructions given above.

INSTALLATION PROCEDURES - STREET CUTS

When boring is not possible because of rock or other conditions which prevent boring, use these procedures:

1. Saw two grooves four inches (4") apart through the street surface material with an asphalt or concrete saw blade attached to a sawing machine.

2. Remove the material between these grooves with a jack hammer and hand tools, then trench the street crossing to the desired depth.

3. After all trenches are tied together with bores under the curbs and gutters, sidewalks, etc., feed the cable into the open trench, through all bores and under all other obstacles to the pedestal locations.

4. Backfill the trench across the street with a slurry mix (one (1) sack cement to one (1) yard of sand and water) up to within two inches (2") of the street surface. Allow one day for the slurry mix to set, then refill the balance of the street cut with asphalt and compact with a small asphalt compactor.

5. Backfill the trench on each side of the street cut according to the other trench backfill instruction in this section. See Figure 7.

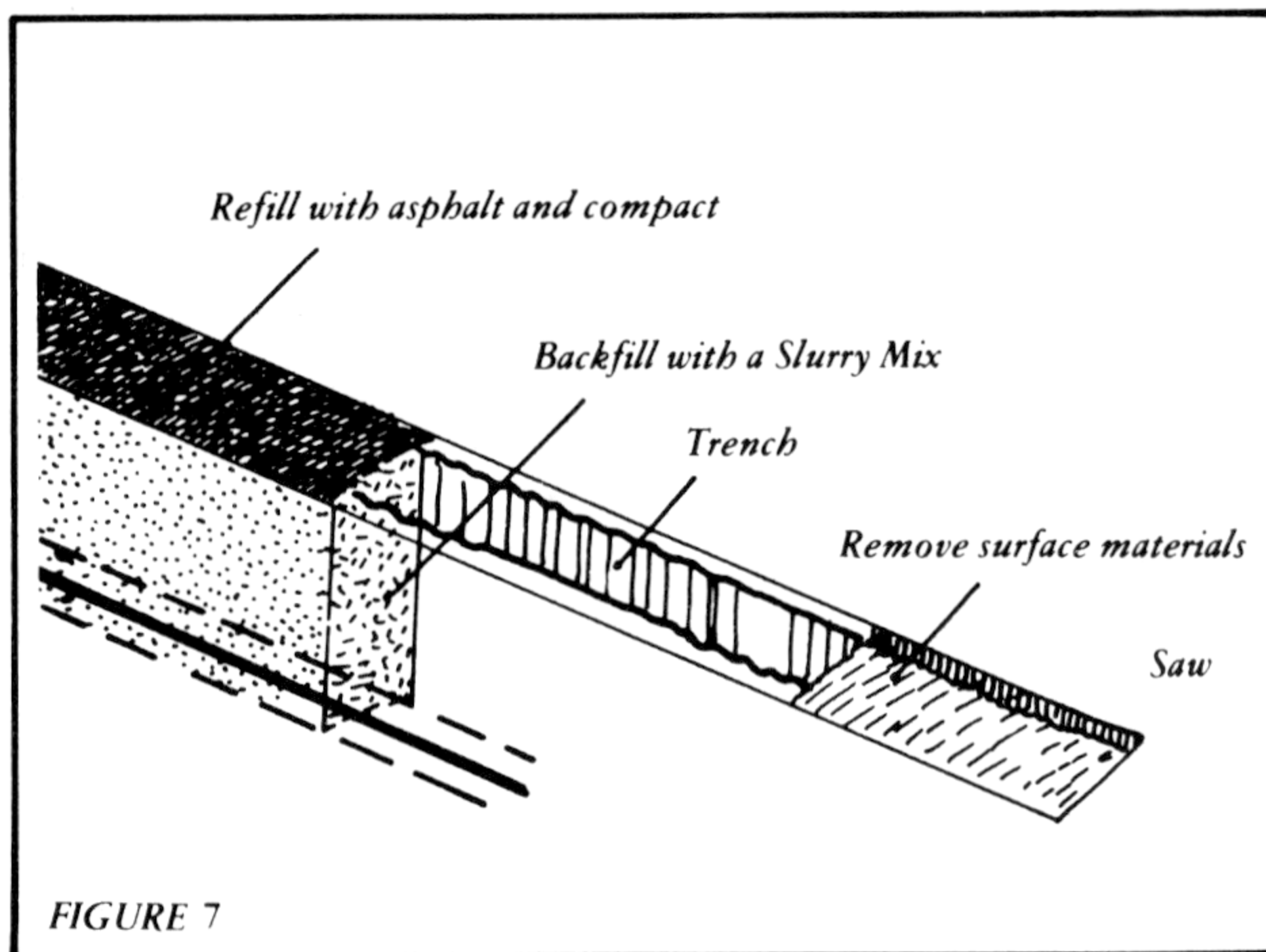


FIGURE 7

Trenching - Multi-Cable Runs

Those procedures followed under "Trenching - Single Cable Runs" are used except all trenches and street bores are left open until all cables are placed and are terminated in their respective pedestals.

The open trench length may be kept short with good design techniques and installation planning. Then all trenches and bore pits are backfilled and the sod replaced.

INSTALLATION PROCEDURES - STREET ROUTES - UNDERGROUND CABLE

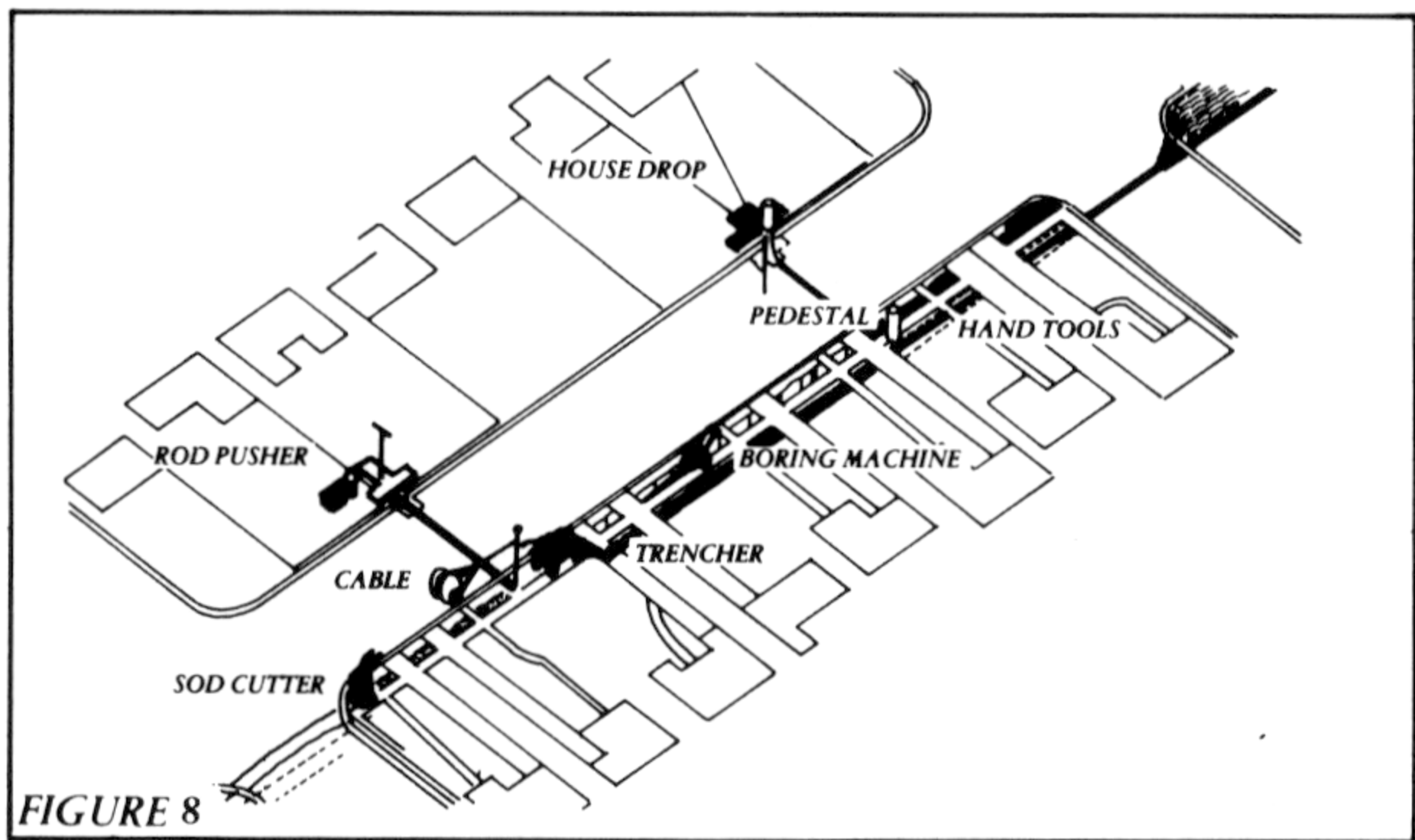
At the installation site where the cable is to be placed along streets, the following procedures are good installation techniques. (See Illustration UG-1 thru UG-6.)

Trenching - Single Cable Routes - Streets

The sod removal, trenching and boring machines are unloaded on the street at the beginning of this underground route.

First the sod cutter cuts a strip of sod along the street between the first two pedestals to be placed. Five foot lengths of the cut sod are removed from the trench line between the pedestal locations.

With a trencher or backhoe, cut bore pits at all street crossings, driveways, and sidewalks between pedestals and routes and bores. (See Figure 8.)



All bores are completed per the boring instructions, and the cable is unreeled into the open trench through all bores and under all obstacles to the pedestal locations. The pedestals are set and the trench and bore pits are properly backfilled. The sod is replaced, tamped and watered. This process continues between all pedestals along the streets.

Trenching Multiple Cable Routes - Streets

When multiple cables are to be buried, the same procedures described under single cable routes apply, except that all trenches and bores are left open until all cables are placed and terminated in all pedestals along the route.

INSTALLATION PROCEDURES - OPEN AREA ROUTES

At the installation site where the cable is to be placed along open areas accessible to equipment and with no crossing obstacles follow these procedures:

Trenching/Plowing - Cable Routes

1. Unload the trenching, sod removal or plowing machine and other tools; take them to the first pedestal location.

2. If trenching, place an offset string line along the trench route between the pedestal location for the trencher to follow in order to dig a straight trench. Cut and remove the sod along the route per the instructions on page UG-89 and start the trencher. Dig the trench past the next pedestal location. Unreel the cable into the open trench and form it across the cable bending jig. Backfill the trench with the backfill blade attachment on the trencher. Tamp the trench route to prevent settlement and replace, tamp and water the sod if removed. See Figure 8.

This same procedure is followed between the balance of the pedestal locations along the balance of the trench route.

3. If plowing, trench a three foot (3') plow blade starting trench at the first pedestal location in the plow route. Place an offset string line along the plow route between the pedestal locations for the plow to follow in order to plow a straight line. Dig a six foot (6') plow blade stopping and starting trench at the next pedestal location. Unreel the cable along the plow route, then feed the cable through the plow blade chute into the open starting trench to the starting pedestal location. Plow the cable into the ground to the next stopping trench. Remove the cable from the chute on the plow blade and form it around the cable bending jig at the pedestal location. Place the cable in the starting trench and through the blade chute, then plow the cable to the next pedestal stopping trench. As each length along the route is plowed, place the pedestals, backfill the trenches, tamp the trenches and plow route and replace, tamp and water all sod which was removed.

This same procedure is followed the entire length of the plow route.

If streets or other obstacles that cannot be trenched or plowed are encountered, following the boring instruction on pages UG-87 thru UG-88 of this section.

INSTALLATION PROCEDURES - CABLE PULLING

When conduit is placed along the cable route or where cable is to be pulled into existing duct facilities follow these procedures:

1. When placing conduit, trench the route per the instructions on page UG-84 thru UG-86 of this Section. Then place the conduit into the open trench between the pedestals or manholes. Spot backfill the trench to hold the conduit into place as it is placed. Prior to placing the 90° elbows on the conduit ends at the pedestal locations, blow a pull line through the conduit. Pull the cable into the conduit. Cut the cable, allowing for adequate cable to reach the top of the pedestals on each end of the route. Slide the 90° elbows over the cable ends and secure them to the conduit. Then backfill the trench and replace the sod per previous backfill instruction. This same procedure is followed between the balance of the pedestals or manhole locations along the balance of the route.

2. When pulling cable into existing duct facilities, first remove the manhole covers, place a manhole guard rail, and safety equipment around the pull location and pump fresh air into the manholes with ventilating equipment. Next, place the cable reel trailer and pulling wench next to the manholes and attach cable rollers and feeders and wench cable blocks above and within the manhole so that the cable and wench line will freely roll into and out of the duct.

Blow a pull line through the duct and cable feeders attached to a line carrier designed to clean out water and dirt as it travels through the

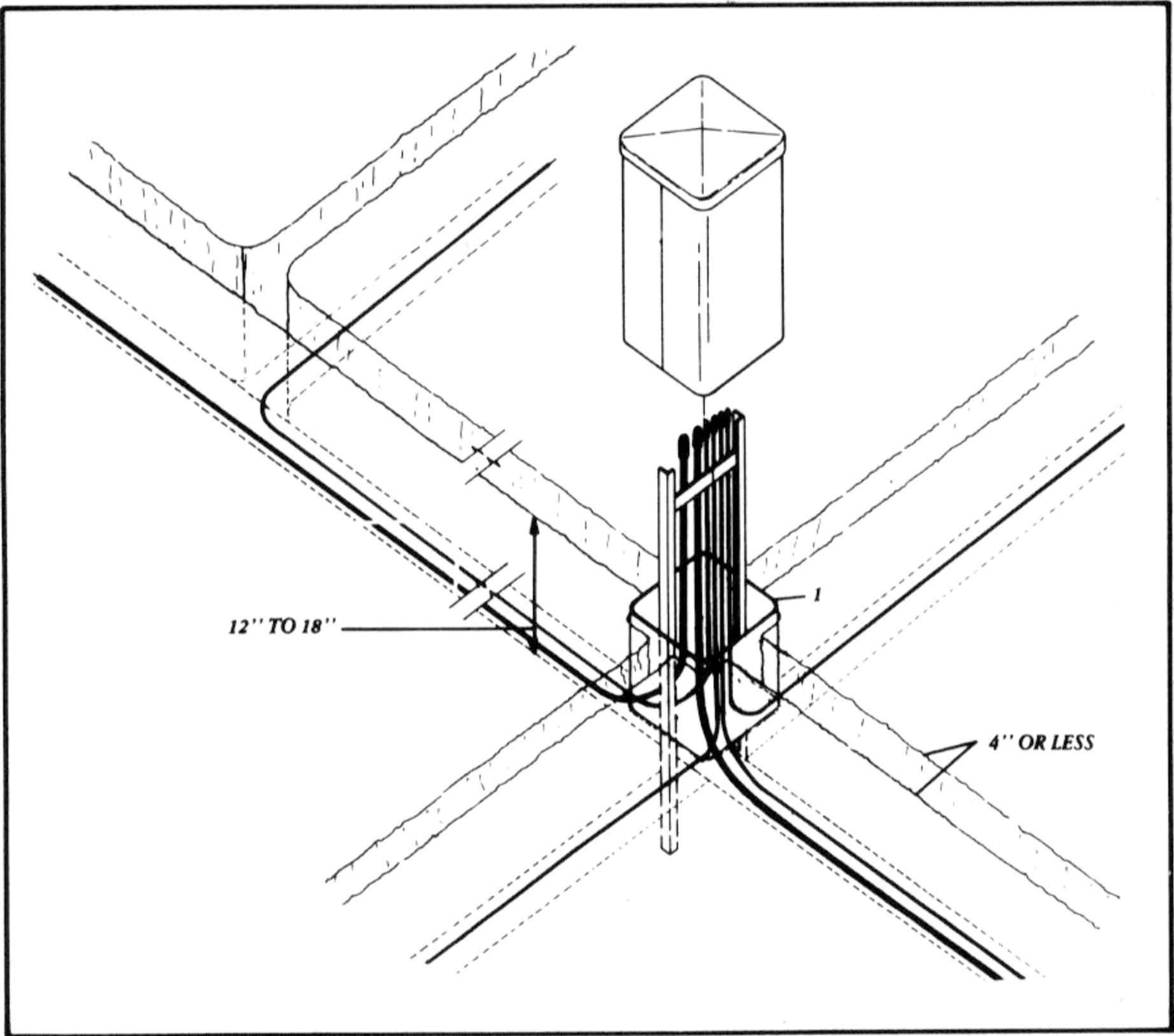
conduit. Attach the pull line to the wench cable and pull the wench cable into the duct with the pull line. Then slip a rotating eye pulling grip onto the cable end and attach the wench line to the eye.

Take up the slack in the wench line while feeding the cable and wench line over all rollers and blocks. As the cable comes off the reel apply a cable lubricating pulling compound to reduce friction as the cable is pulled through the duct. When pulling long and difficult routes use the dynamometer to measure the pulling tension on the cable to confirm that the maximum pulling tension specification of the cable is not exceeded.

UNDERGROUND CABLE INSTALLATION PROCEDURES

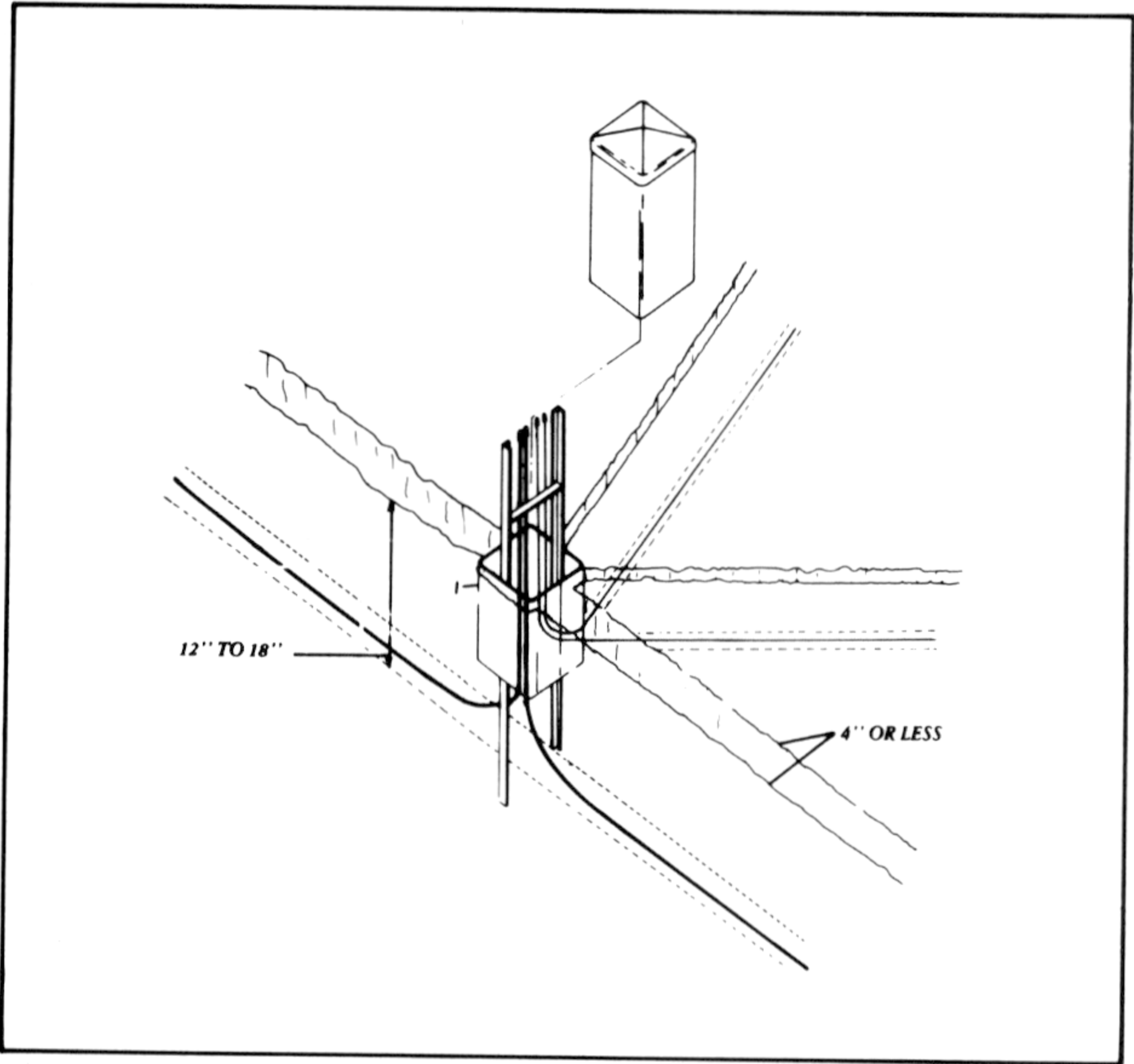
UNDERGROUND ILLUSTRATIONS

	Page
Figure UG-1 Amplifier Pedestal	UG-93
Figure UG-2 Passive or Tap Pedestal	UG-94
Figure UG-3 Tap Pedestal	UG-95
Figure UG-4 Vault	UG-96
Figure UG-5 Amplifier Pedestal/Conduit	UG-97
Figure UG-6 Vault with Conduit	UG-98



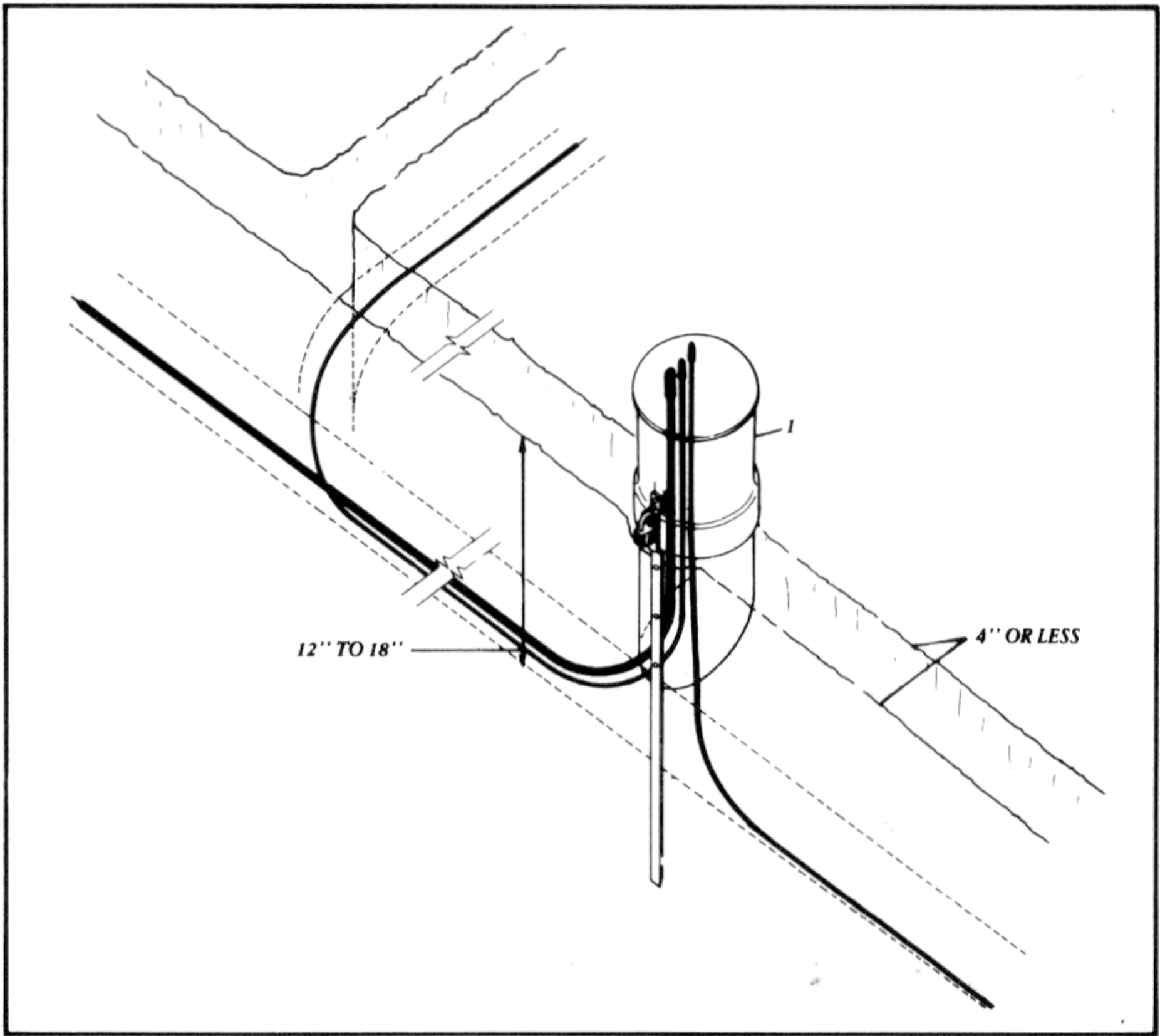
<i>Item</i>	<i>Description</i>
<i>1</i>	<i>Amplifier or Power Supply Pedestal</i>

FIGURE UG-1 AMPLIFIER PEDESTAL



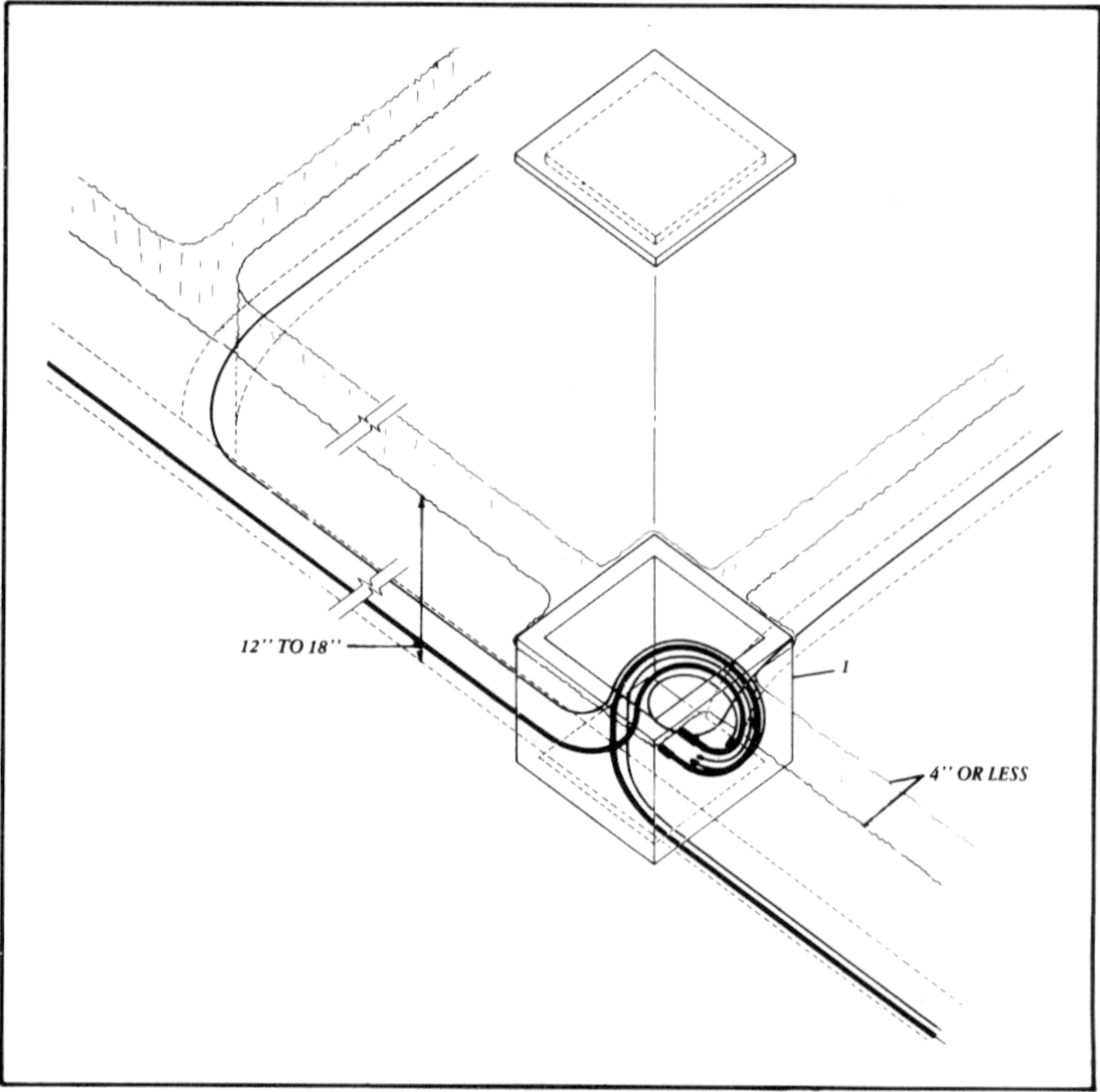
<i>Item</i>	<i>Description</i>
1	Passive or Tap Pedestal

FIGURE UG-2 PASSIVE OR TAP PEDESTAL



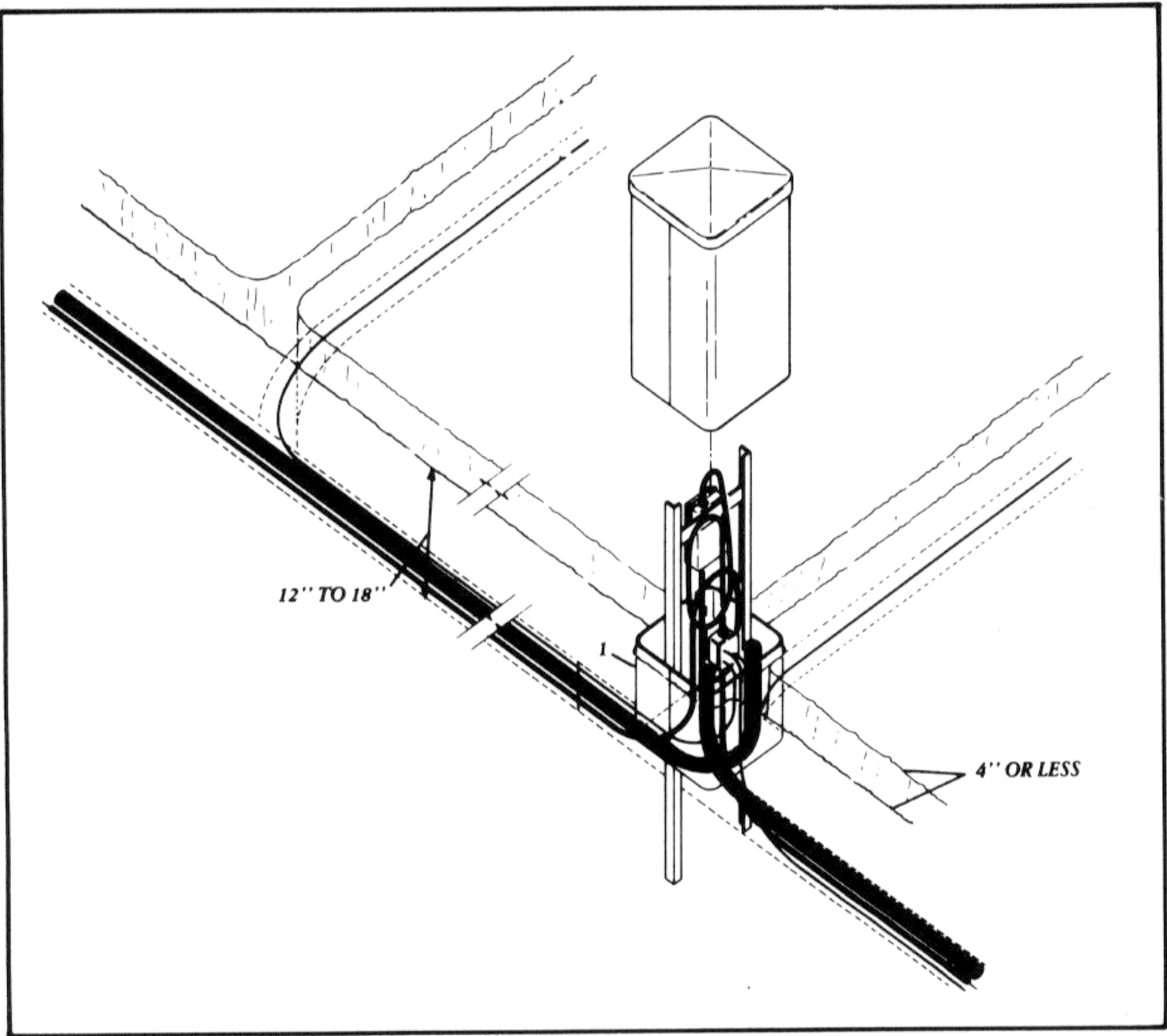
<i>Item</i>	<i>Description</i>
1	Tap Pedestal

FIGURE UG-3 TAP PEDESTAL



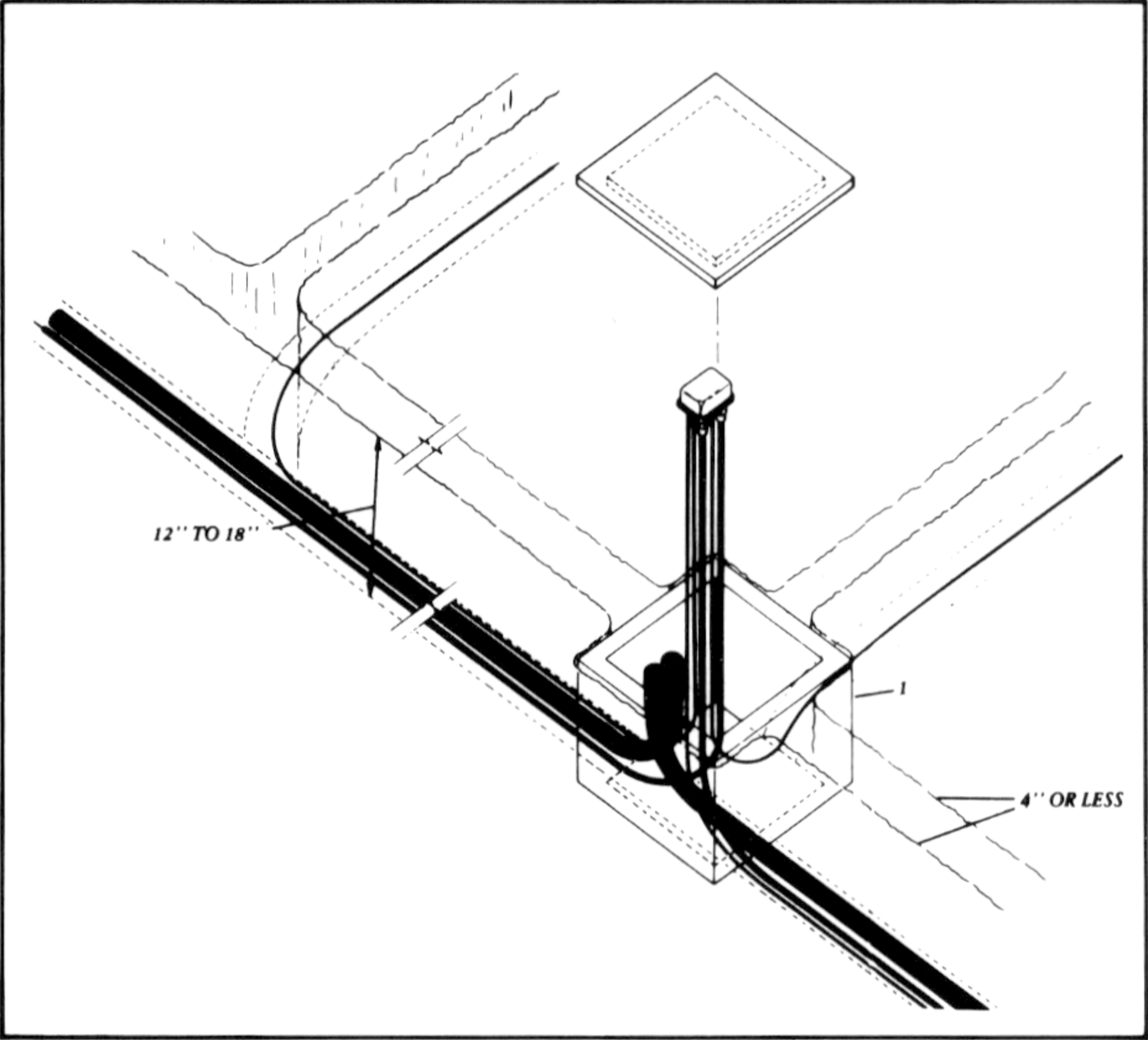
<i>Item</i>	<i>Description</i>
1	Flush Mount Vault

FIGURE UG-4 VAULT



<i>Item</i>	<i>Description</i>
1	Amplifier Splicing Pedestal-Conduit

FIGURE UG-5 AMPLIFIER PEDESTAL/CONDUIT



<i>Item</i>	<i>Description</i>
1	Vault with Conduit

FIGURE UG-6 VAULT WITH CONDUIT

Special Installation Procedures Reference Data

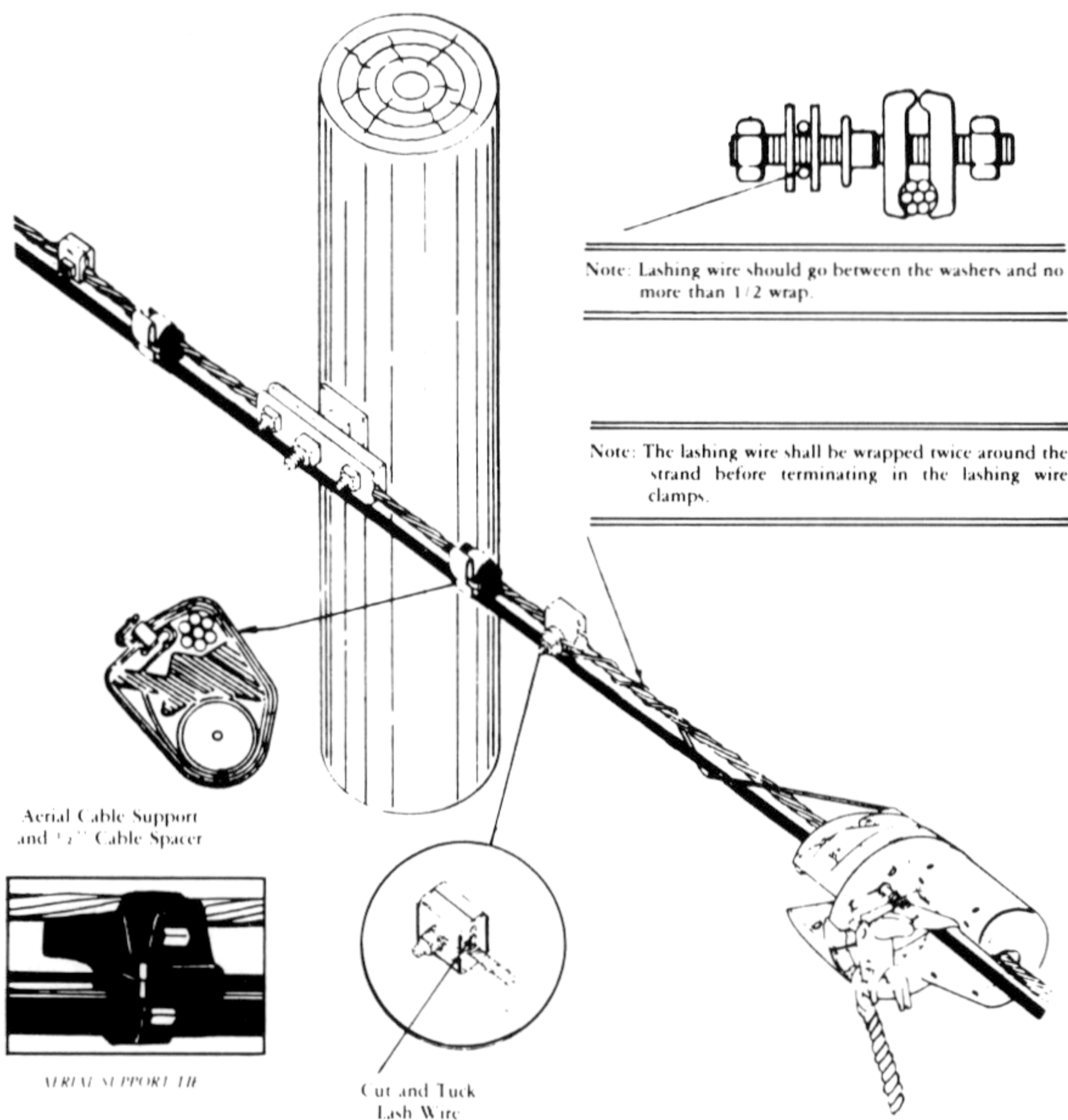
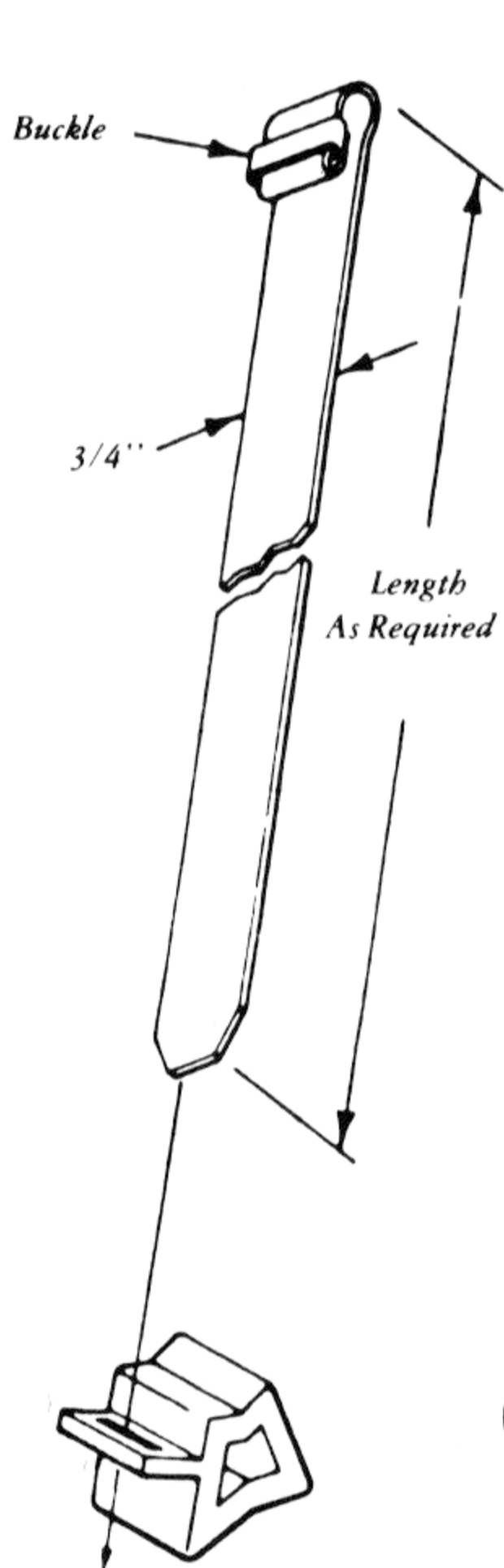
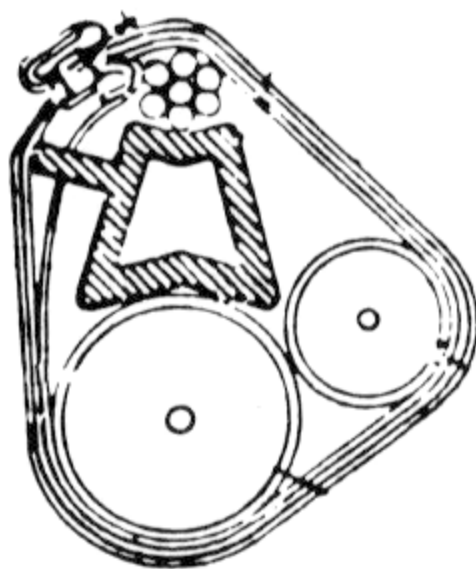


FIGURE 1 CABLE PLACING - LASHING WIRE CLAMP -
AERIAL SUPPORT AND SPACER
SR-100

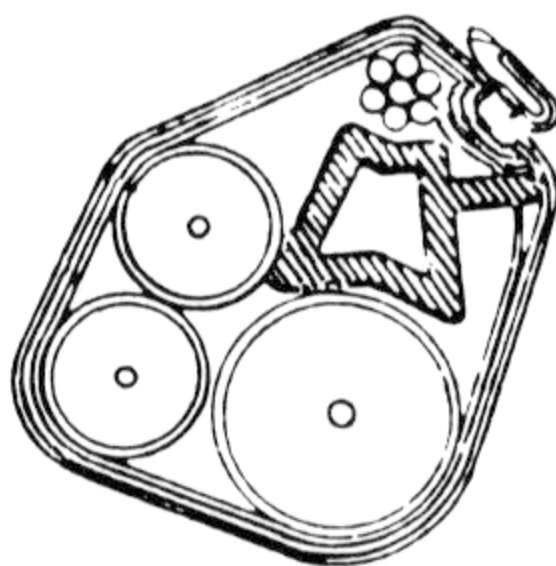
FIGURE 1 CABLE PLACING - LASHING WIRE CLAMP -
AERIAL SUPPORT AND SPACER



Single cable with spacer
and aerial support



Dual cable with spacer
and aerial support



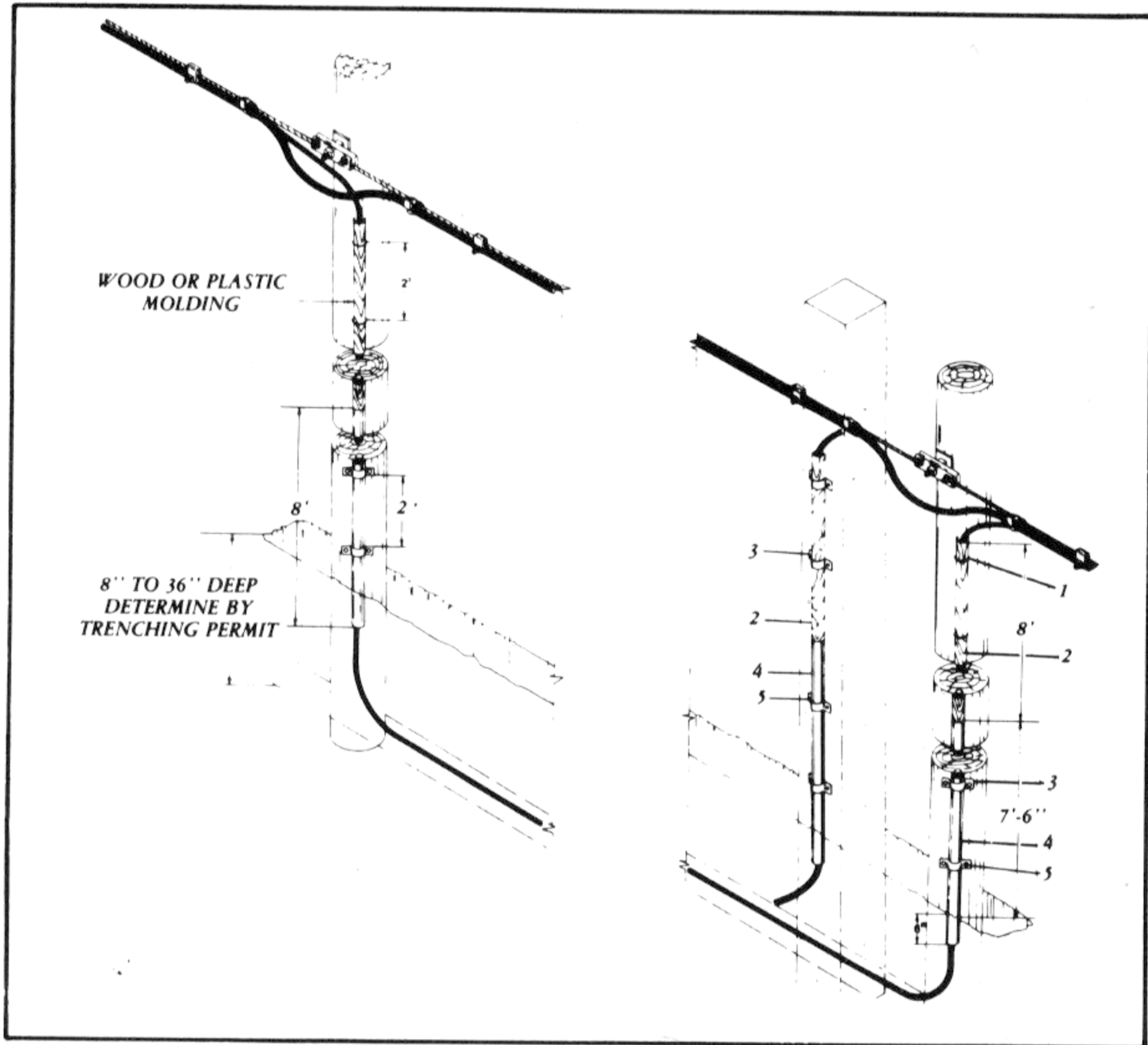
Triple cable with spacer
and aerial support

Note: Wrap the aerial support around the strand and cable(s) 2 or 3 times. Pull each wrap tight, then fold the support under itself passing it through the buckle, then fold back over the buckle.

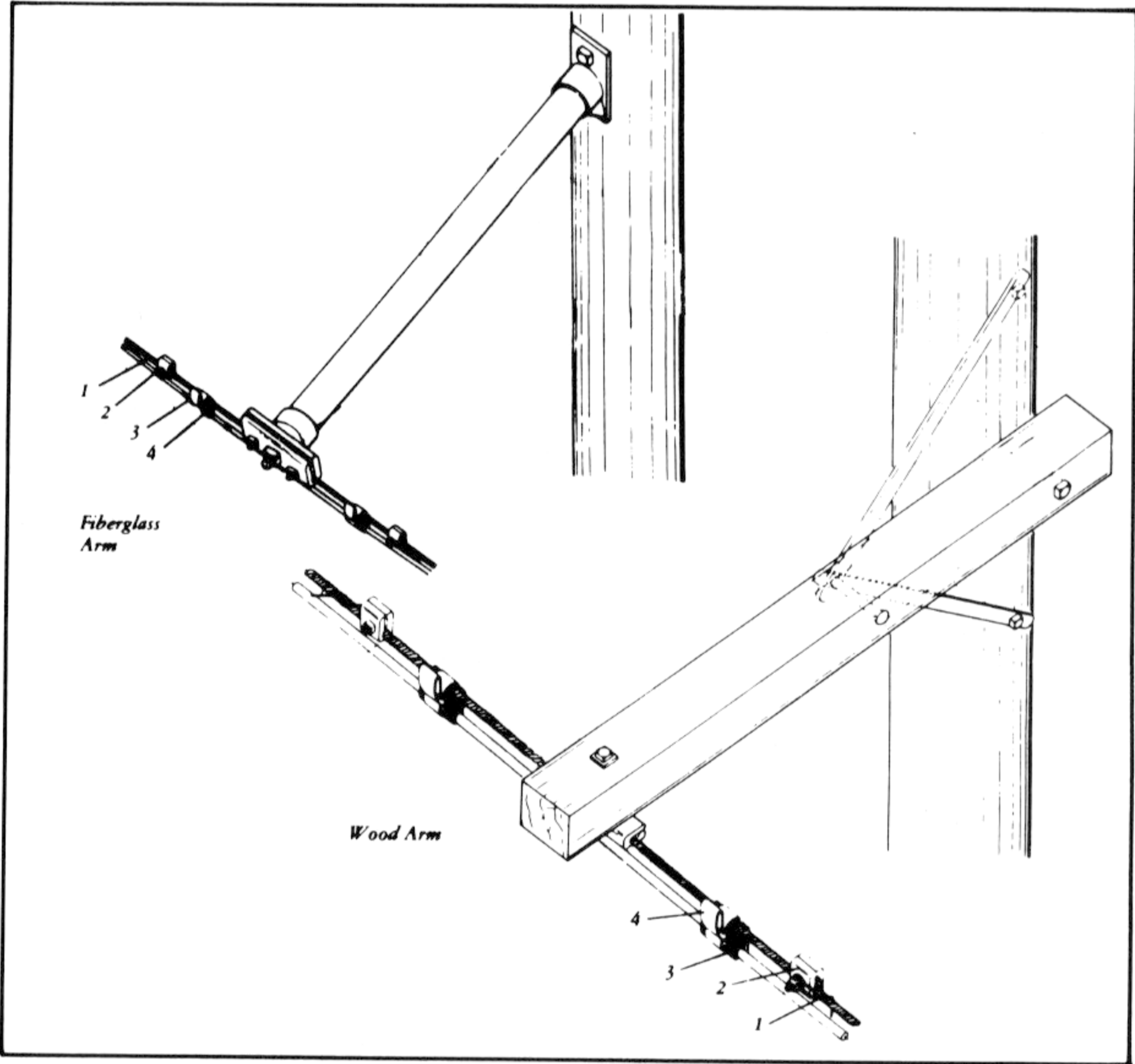
FIGURE 2 CABLE PLACING - AERIAL CABLE SUPPORT AND SPACER

INSTALLATION PROCEDURES - UNDERGROUND DIPS

At locations where it is necessary to place small portions of cable underground, the installation procedures shown in Figure 3 should be followed.



It is recommended that all underground cables be solid dielectric. Coppergard® or Aluminum foam dielectric with jacket and flooding compound. All splices made on underground dips are made on the poles at the strand level on each side of the dip, or in pedestals. The splices should not be buried.



Fiberglass Arm		Wood Arm	
1	0.045 Stainless Steel Lashing Wire	1	0.045 Stainless Steel Lashing Wire
2	Lashing Wire Clamp	2	Lashing Wire Clamp
3	Cable Spacer	3	Cable Spacer
4	Cable Support Strap	4	Cable Support Strap

FIGURE 4 CABLE PLACING - EXTENSION ARMS

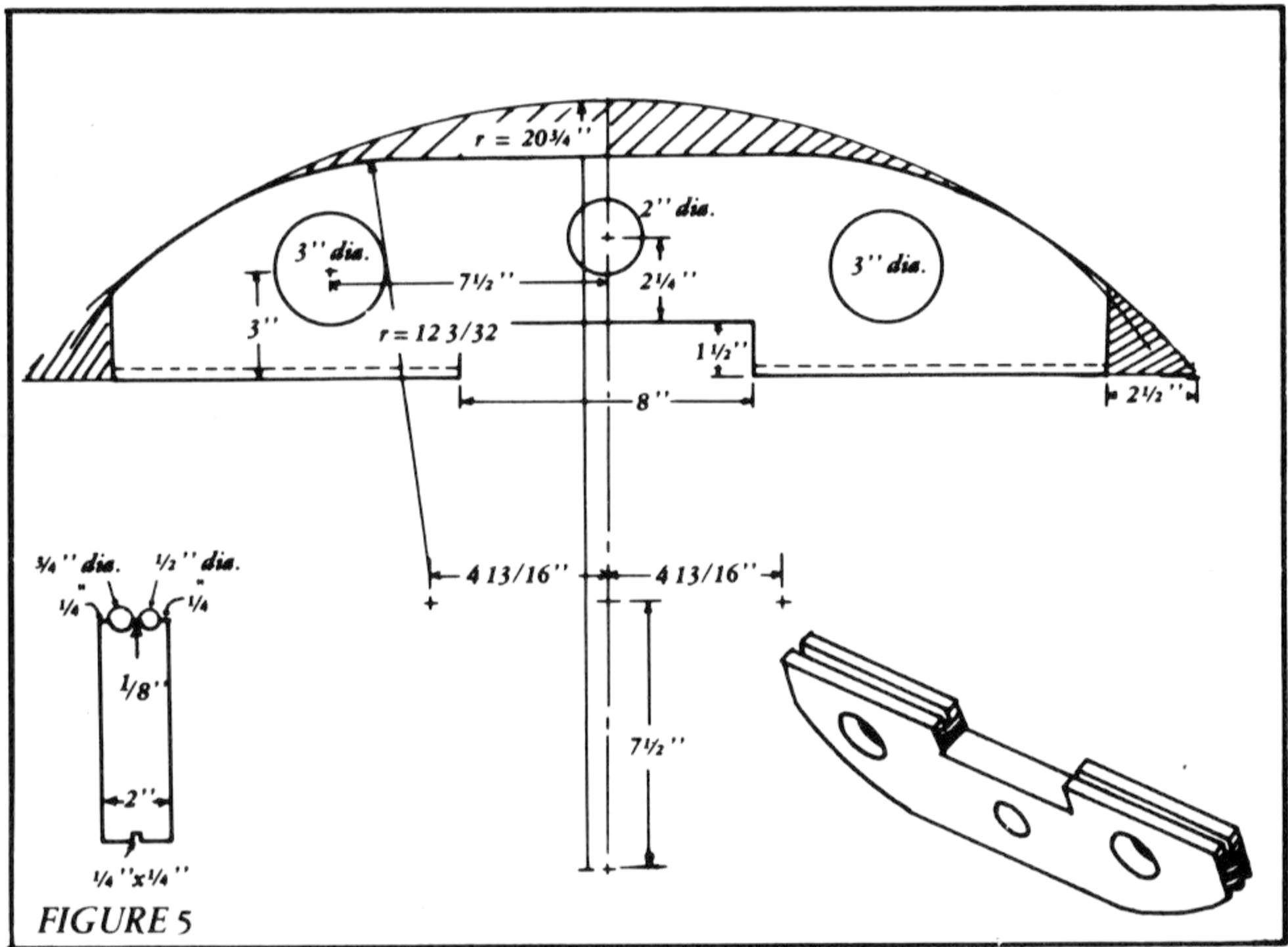
EXPANSION LOOPS

In all cases, expansion loops should always be formed with a tool designed for the purpose and never by hand.

Expansion loops are formed at non-equipment locations with a fabricated expansion loop forming tool. (See Figure 5 and 6). At locations where amplifiers passive devices, power supplies and taps are installed, an expansion loop/bending radius tool is used.

FABRICATED LOOP FORMING TOOL

If locally fabricated forming tools are used, they should conform to the shape and dimensions as described in Figure 6.



For 1.0" inch cables mechanical expansion loop tools are recommended. See Figure 6.

